STATE ALGEBRA EXAMINATION

AND SPECIAL EDUCATION: CHANGE IN GRADUATION REQUIREMENTS

by
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Abstract

In the state studied in this investigation, the state high school diploma is the only type of diploma graduates from high school receive. The revised state diploma includes the requirement of passing specific courses and their prospective examinations (i.e., life science, physical science, algebra, global history, U.S. History, and English). These new state graduation requirements include passing the algebra course and corresponding final state algebra examination for all high school students including students in special education programs. The study explored implementing an option that extends the traditional one year algebra course over a period of two-years that may improve algebra achievement for students with a disability. The intervention of a 2-year algebra course for students with a disability included small class enrollment, instructional intervention support, and specific algebra course instructional strategies focused on solving algebra word problems. School district data indicated students with a disability who failed the Grade Eight State Mathematics Assessment were likely to fail the final state algebra examination. After the implementation of a 2-year algebra course in a suburban high school, the passing rate on the final state algebra examination for students with a disability was not conclusive because statistically significant findings were only found in one of the two years studied. Another study to further examine additional years of students' test score performance on the final state algebra examination is warranted.

Keywords: algebra, state algebra examination, Individual Education Program (IEP), special education, and high school diploma.

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DEDICATION

To my beloved husband, Tom, thank you for making my dream of earning my doctorate come true. You are my best friend, cheerleader, and a constant source of support. I could not have achieved this goal without your endless love and encouragement. Not a single day goes by that I do not thank my lucky stars for having you in my life.

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Chapter 1. Executive Summary

In one northern Atlantic state in the United States, a revision in the high school graduation diploma resulted in the regulation that all students must now earn a rigorous state high school diploma to graduate. As of September 2013, students entering high school with a disability had to meet these diploma requirements for the state high school diploma, with a specific requirement to receive an algebra credit. An algebra credit is earned by successfully passing both an algebra course and the final state algebra examination – a summative assessment administered at the conclusion of the year. The study examined the implementation of a 2-year long algebra course developed as a strategy to improve students with disabilities (SWD) performance on the final state algebra examination.

A change in the high school diploma increased enrollment in grade nine algebra for all student learners including students with disabilities; regardless, of their mathematics performance in middle school. Findings from the needs assessment revealed that there was a relationship between student performance on the Grade Eight State Mathematics Assessment and student performance outcomes on the final state algebra examination. Ninety-eight percent of students in the identified high school district, who failed the Grade Eight State Mathematics Assessment, also failed the final state algebra examination. Student enrollment eligibility for the 2-year algebra course included all of the following criteria: (a) disability, (b) failing the Grade Eight State Mathematics Assessment, and (c) entering grade nine. The development of the 2-year course was by teachers from the identified school district and was co-taught by both a general education teacher and a special education teacher. The format of the course included small class enrollment, Resource Room placement, and specific strategies to support student achievement in the 2-year algebra course.

The purpose of the study was to examine if a 2-year algebra course option improved the performance of SWD on the state's algebra examination required for graduation. Two findings from the study supported the implementation of the 2-year algebra course option. First, the implementation of the 2-year algebra course for 2015 and 2016 promoted a yearly increase for all students passing the final state algebra examination. Passing performance suggests the program was effectively supporting student proficiency in algebra. In 2015, 48 students from the identified high school with a disability took the final state algebra examination. Sixteen of the 48 SWD passed the 2015 final state algebra examination. Fifteen of the 16 students who successfully passed the examination had taken the 2-year algebra course. In 2016, 51 SWD participated in the final state algebra examination, and 29 of those students passed. Twenty-seven of the 29 SWD who passed the examination had taken the 2-year algebra course. Two SWD who had taken the 1-year algebra course passed the June 2016 final state algebra examination. In summary, more enrolled SWD who were enrolled in the 2-year algebra course are passing the final state algebra examination.

The student performance on the Grade Eight State Mathematics Assessment showed a statistically significant relationship to student performance on the final state algebra examination. Most students, who failed the Grade Eight State Mathematics Assessment in the identified school district, failed the final state algebra examination. Student performance on the Grade Eight State Mathematics Assessment remained a valid indicator in deciding which students would benefit from the 2-year course option.

In summary, one school district believed SWD who did not pass the Grade Eight State Mathematics Assessment entering grade nine would benefit from enrolling in a 2-year algebra course. Enrolled SWD who were in the 2-year algebra course had a 57% chance of passing the final state algebra examination as compared to the 12% passing rate for SWD performance in the 1-year algebra course. This study supports the continued implementation of a 2-year algebra course to help SWD successfully achieve proficiency on the required final state algebra examination.

Chapter 2. Literature Review of Problem

Context

School districts, high schools, and classroom' leadership from several states including California, Connecticut, and Massachusetts have made adjustments in response to new high school graduation requirements becoming standardized for all students (California Department of Education, 2016; Connecticut Department of Education, 2016; Massachusetts Department of Elementary and Secondary Education, 2016). As of fall of 2013 in one state in the United States, all SWD, entering high school as a ninth grader could only graduate from high school by meeting the requirements of the state diploma (State Education Department [SED], 2016b). Students with the disability previously had the option to earn a State Local Diploma, which was a less rigorous high school diploma. Less rigorous in that students were not required to pass specific courses and state examinations to graduate from high school. Individual school districts had the flexibility to develop and implement specific high school mathematics and science courses with less rigorous content for students earning a State Local Diploma.

Many states updated graduation requirements to require high school students to pass an algebra course for graduation (California Department of Education, 2016; Connecticut Department of Education, 2016; Massachusetts Department of Elementary and Secondary Education, 2016). These updated graduation requirements for the state diploma include passing a specific number of subject area courses and the state standardized final examination for each course. Previously students entering grade nine enrolled in a 1-year long state algebra course. The change in graduation diploma requirements held all students including those with a disability to the same standard of performance as students without special needs (Steele, 2010).

Theoretical Framework

Cognitive learning theory examines how students learn and comprehend new information and support teachers to focus on how students acquire information to be learned and relate it to knowledge in memory, store new knowledge in memory, and retrieve knowledge as it is needed (Flavell, 1979; Schunk, 2008). Cognitive learning theory describes the thinking processes affected and shaped by various (i.e., internal and external) aspects in order to construct learning in students. For students to recall prior learning accurately and immediately, they require the knowledge and information to undergo "the process of assigning meaning to a stimulus" (Schunk, 2008, p. 133). The cognitive learning theory explains the way information is processed and guides educators so that concepts within the curriculum are learned. Cognitive psychology is a theoretical perspective concentrated on recognizing individual awareness, thought, and retention. It depicts individuals as active processors of information and assigns key roles to the comprehension and outlook that individuals bring to the learning process in school (Bruning, Schraw, & Norby, 2011). Cognition information processing concentrated on how individuals attend to situational events, translate information to be comprehended and relate it to data in memory, store new learning in memory, and retrieve the knowledge when needed (Schunk, 2008). The cognitive learning theory perspective looks at how humans process information; frequently referred to as the "frameworks of comprehension" (Bruning et al., 2011, p. 1).

The cognitive learning theory processes include observing, categorizing, and forming generalizations about one's environment. The use of cognitive learning theory strategies can increase the effectiveness with which the student approaches an academic task. Actively engaging students in remembering and applying information from course content support understanding and retention. Bruning et al. (2011) discussed the cognitive learning theory perspective for educating students with the purpose to convey knowledge to enable students to form meaningful connections. Instruction of new academic content to students should be targeted with the intent to support the learning needed for understanding and retention. Providing opportunities for students to demonstrate their comprehension of new learning with practice opportunities (i.e., repetition) in the classroom is important for mastery of knowledge. Educators may find benefits from using the cognitive learning theory when teaching SWD because the theory suggests using concrete approaches to learning (Flavell, 1979). Concrete learning theory approaches are known to support student comprehension and mastery of rigorous content in academic courses (Bruning et al., 2011; Flavell, 1979). The cognitive learning theory gives attention to what goes on inside the student's brain and focuses on mental processes rather than observable behavior. Use of cognitive information processing is when the student plays an active role in seeking ways to comprehend and process the information it receives and connects it to what is already accumulated and stored within memory. Comprehension involves the reorganization of occurrences, either by attaining new perceptions or changing old insights. The acquiring of knowledge is a change in learning which is stored in memory. Mastery of comprehension content in academic courses needs to include lesson activities to reinforce instruction for students to deeply learn the academic concepts. Students using concrete models (i.e., manipulatives, graphic organizers) are able to visualize and understand how to build on the knowledge to retain the learning and retrieve the knowledge when required (i.e., homework, chapter tests, final examinations).

The cognitive learning theory encourages active engagement activities to improve student learning. Many students need to be actively engaged in learning to optimize academic outcomes (Maccini, Mulcahy, & Wilson, 2007). Cognitive learning theory provides a framework for teachers to improve students' performance in algebra and provides teachers with multiple modes of delivery to help students understand abstract concepts found in algebra by using manipulatives (i.e., algebra pattern blocks) to measure and determine a solution for an algebraic topic. The cognitive learning theory perspective allows educators to understand ways information is processed and guides educators to develop lessons (i.e., small group activities and corresponding assessments) within the course curriculum, so the concepts within the curriculum are learned, stored, and able to be retrieved successfully.

The cognitive learning theory includes the different cognitive approaches and models developed by cognitive theorists. Cognitive Themes for Education, a cognitive learning theory approach, promotes student achievement in academic content areas (Bruning et al., 2011). The purpose of the Cognitive Themes for Education is to ensure students are able to learn and recall information accurately. These eight themes discuss the cognitive perspective for educating students. Educators and schools should use the Cognitive Themes for Education to implement instructional strategies to enable students to form meaningful connections from information learned. The eight themes include (a) “learning is a constructive, not a receptive, process,” (b) “mental frameworks organize memory and guide thought,” (c) “extended practice is needed to develop cognitive skills,” (d) “development of self-awareness and self-regulation is critical to cognitive growth,” (e) “motivation and beliefs are integral to cognition,” (f) “social interaction is fundamental to cognitive development,” (g) “knowledge, strategies, and expertise are contextual,” and (h) “a cognitive approach to teaching implies new approaches to assessment” (Bruning et al., 2011, pp. 6-9). Each of these themes was recommended to educators and school leadership to support students to form meaningful connections with information learned (Flavell, 1979).

The Cognitive Themes for Education (Bruning et al., 2011) support the cognitive learning theory of instruction for students who struggle academically in school, and need the support of instructional interventions to improve comprehension and retention of learned content (Bruning et al., 2011). Creating opportunities within the school day for students to get the necessary instructional intervention support in a small setting (i.e., Resource Room or school learning center) can improve students’ mathematics scores. In algebra class, some students do not absorb and comprehend concepts taught with a teacher lecturing in front of the classroom and not actively involving student participation (Gagnon & Maccini, 2007). Students need to be actively learning and motivated with lessons that provide students with multiple opportunities to demonstrate knowledge and comprehension (Bruning et al., 2011). The Cognitive Themes for Education can provide a framework for teachers to improve student performance in the algebra course. Bruning’s (2011) ideas support teachers to incorporate varied activities, intervention instructional opportunities, and hands-on manipulatives to understand abstract concepts found in the algebra class. One purpose of the Cognitive Themes for Education is to create opportunities for students who do not possess previous learning concepts to develop ways to retain new information with alternative teaching strategies (Bruning et al., 2011). Students need to learn instructed concepts to recall the ideas accurately. The Cognitive Themes of Education provide suggestions as to how educators can improve the learning environment and make it more successful for students (Anderson, 2005; Bruning et al., 2011; Eysenck & Keane, 2005; Flavell, 1979; Schunk, 2008).

Cognitive learning theory is the most appropriate of all of the learning theories to address the problem of practice of requiring all SWD to achieve proficiency in algebra to graduate from high school. The constructivist learning theory focuses on knowledge gained from experiences; however, many of the SWD did not successfully learn foundational pre-algebra skills prior to entering high school, and their past experiences with mathematics would not support success in algebra (Ertmer & Newby, 1993). Sociocultural learning theory emphasizes the impact of home life and cultural issues impacting learning (Vygotsky, 1978). Sociocultural learning theory would not provide the focus for examining the algebra course environment to improve the achievement for SWD. The problem of practice was examining how to improve the delivery of the algebra course content to improve student achievement, and the cognitive learning theory best supports the studied objective. In summary, cognitive learning theory stresses the key ideas of attention, retention, recall, and production. These key ideas need to be examined to address the problem of practice to improve student achievement in algebra.

In summary, the cognitive learning theory relates to the problem of practice because it allows school leaders and teachers to understand the barriers students experience when they do not achieve proficiency in high school mathematics (Maccini, Mulcahy & Wilson, 2007). The cognitive learning theory provided suggestions to how educators can improve the learning environment and make it more successful for students. The cognitive learning theory relates to the problem of practice because it allows one to understand the barriers students face when previous mathematics courses and examinations are not passed successfully in middle school. Furthermore, the suggestions from cognitive learning theory to implement particular methods such as extended practice activities to correct and improve student achievement may increase the level of learning in algebra class. The Cognitive Themes for Education suggest using the implementation of instructional approaches of the eight themes to improve and support student comprehension. Lastly, each of the Cognitive Themes for Education assists educators and schools in teaching knowledge that is usable and to enable students to form meaningful connections from information learned.

Conceptual Framework

The cognitive learning theory emphasizes the importance of understanding ways students learn academic material. The curriculum content learned, stored, and successfully retrieved are key components of the cognitive learning theory (Flavell, 1979; Schunk, 2008). The cognitive learning theory helps to provide a framework to examine the problem of practice investigated in this study; for all grade nine SWD to achieve proficiency on the state algebra exam as a requirement for high school graduation. The initial Conceptual Framework (Figure 2.1) was provided to visually identify the key factors associated in the study with the potential problem of earning an algebra credit to graduate from high school. The identified problem of practice relates to how a revised high school diploma policy, which includes specific course requirements, specifically algebra, mandated for graduation impacts SWD earning an algebra credit needed to graduate from high school.

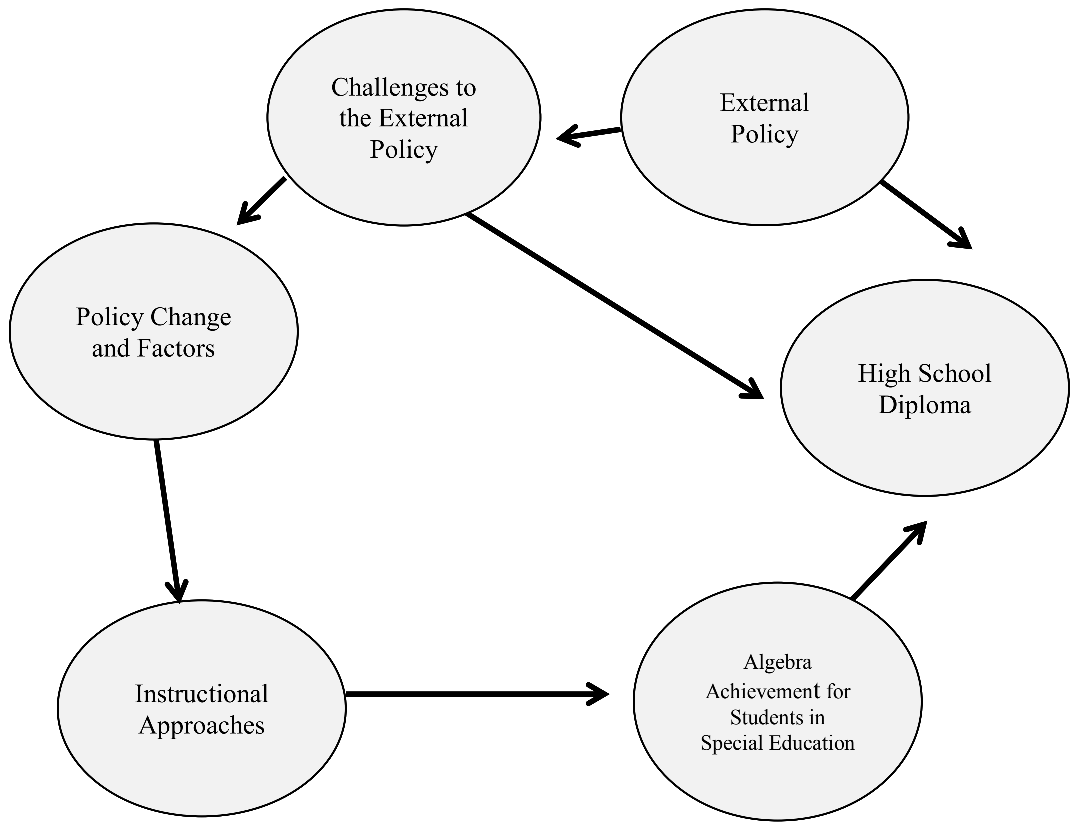

Figure 2.1. Conceptual framework.

The graphic above, Conceptual Framework (Figure 2.1), illustrates the anticipated relationships between concepts chosen for examination in this study. Each oval in the illustrated graphic organizer represents the key factors examined in the literature review to show how the factors (i.e., course instructional approaches, external policy, high school diploma, and algebra achievement for SWD) were linked to earning an algebra credit to fulfill a high school graduation requirement. Instructional approaches and challenges responding to external policy were factors (i.e., ovals) examined in the study, specifically in the Literature Review of Problem, impacting the achievement of algebra for SWD. The initial Conceptual Framework (Figure 2.1) identifies the key factors within the study for examination of SWD required to earn an algebra credit to graduate from high school. The key factors and how each factor impacts the other factors included in the Conceptual Formation were:

- High school diploma is the goal for all high school students to achieve.
- External policy represents educational policies to include *A Nation at Risk* (U.S. National Commission on Excellence in Education, 1983) and No Child Left Behind [NCLB] (2001) that persuaded state education departments to increase the required number of mathematics courses taken in high school and the mandate to achieve proficiency in algebra to earn a high school diploma. The external policy impacts the high school diploma to determine what is required of high school students.
- Challenges to the external policy were impacted by both the external policy and the high school diploma. High schools need to provide an algebra course to prepare students to pass the required state final algebra examination to attain algebra proficiency (DeBray, 2005). The challenges to the external policy need to consider the implications of teacher preparation time and funding to implement an algebra course to support student achievement for all learners (DeBray, 2005; Mehta, 2013).

- Policy change represents the rationale for making algebra a gatekeeper course to prepare students for other mathematics and science courses they will take in high school and college (Daun-Barnett & St. John, 2012; Gulick, 2012). Policy change impacts both instructional approaches and algebra achievement for SWD. The algebra course needs to be instructed to attend to the needs and levels of learners enrolled in the course. Instructional approaches implemented by the algebra co-teachers and SWD enrolled in the algebra course were affected by policies requiring algebra proficiency.
- Instructional approaches support students learning in the algebra course. The large number of students enrolled in the algebra course make it a challenge for teachers to improve student understanding of key algebraic elements (Ellerbrock & Kiefer, 2013; Glass & Smith, 1978). In the algebra course, the teachers need to connect with individual students during the algebra course lessons to examine their understanding and be able to make changes to support student learning. Professional development learning opportunities for algebra co-teachers need to be offered to learn instructional strategies to help all student learners achieve algebra proficiency (Foegen, 2008).
- Algebra achievement for SWD was a contributing factor to earning the high school diploma. The high school diploma mandates all learners (i.e., general education and special education) must attain proficiency in algebra. The factors of policy change and instructional approaches

> influence the instruction and learning for algebra achievement for SWD. Idol's (2006) study outlines the importance of providing instructional interventions to improve the achievement for SWD in the general education classroom setting.

In summary, "cognition information processing theories focus on how people attend to environmental events, encode information to be learned and relate it to knowledge in memory, store new knowledge in memory, and retrieve it as we need it" (Schunk, 2008, p. 130). The strength of using the cognitive learning theory was to support students who do not have previous learning concepts to develop ways to retain new information with alternative teaching strategies. Students need to learn concepts instructed to them successfully and to accurately recall these concepts in the future. The cognitive learning theory relates to the factors included in the Conceptual Framework (2.1) by providing a foundational understanding to make sense of the findings and to explain the results of the study. Furthermore, the analysis of research will attempt to identify relationships among the constructs included in the Conceptual Framework.

Statement of the Problem

An educational policy for all high school students to pass an algebra course and a final examination resulted in more SWD taking the final examination. The new policy increased numbers of overall test takers which resulted in an increased overall failure rate with a disproportionate increase in failure rates for SWD (Steele, 2010). Prior to 2013, students in the identified state could earn a Local State High School Diploma without passing an algebra course or without a passing score on the final state algebra examination (SED, 2016b). Under the prior SED (2016b), forty-six percent of SWD graduated with the identified state's Local Diploma (DeBray, 2005; SED, 2016b).

Purpose of the Study

The purpose of the study was to explore how one high school providing a 2-year algebra course option can improve the performance on the final state algebra examination for SWD. On average only 54% of SWD were meeting the requirements for the revised graduation diploma requirements (SED, 2016c). Therefore, in addition to studying the impact of the algebra requirement, the study assessed how one high school within the identified state, could improve algebra instruction by creating a 2-year algebra course to increase proficiency for students with the disability. The identified school district implemented a pilot for a potential extended algebra course option in one of the two high schools located within the school district. The rationale was to implement the course option to be sure the expense of funding the extended course would produce an increase in passing scores on the final state algebra assessment. Furthermore, the study examined whether the State Grades Seven and Eight Mathematics Assessments were a possible correlation of performance for students with the disability on the final state algebra examination. Most SWD from the identified school district who do not pass the Grades Seven and Eight State Mathematics Assessments do not pass the final state algebra examination.

Review of Literature

The review of literature identified both policies and studies to understand the investigated problem of practice. Each policy and study provided an in-depth understanding to show the challenges for mandating SWD to pass algebra to graduate from high school. The review of literature demonstrates the reasons to research the problem of practice further.

External Policy

Educational policies in the United States of America shape the requirement for students to achieve in school. *A Nation at Risk* (U.S. National Commission on Excellence in Education, 1983) and NCLB (2001) were influential policy recommendations that allowed states to reflect on the quality of education students were receiving and how instructional effectiveness could be improved (Alexander, 2003; Mehta, 2013). Both documents criticized state education agencies for setting low expectations with respect to the number and rigor of mathematics and science courses required for high school graduation. One of the five goals for A *Nation at Risk* (1983) report recommended was for states to increase the number of content courses students were required to take in high school (i.e., four years of English, three years of social studies, three years of mathematics, and three years of science). NCLB (2001) required states to develop and implement assessments to all students at select grade levels to receive federal education funding. Both documents criticized state education agencies for setting low expectations on the number and rigor of mathematics and science courses required for graduation.

In 2000, the National Council of Teachers of Mathematics created guidelines, *Principles and Standards for School Mathematics* (PSSM), which were a thorough set of mathematics standards for students to improve their achievement in mathematics (NCTM, 2016). PSSM outlines the essential elements of a high-quality school algebra and mathematics program. It stresses the need for organized and well-supported teachers and administrators; it supports the importance of a thoroughly organized system for assessing students' learning and a program's effectiveness. The four PSSM are: a) "Set forth a comprehensive and coherent set of learning goals for mathematics for all students from prekindergarten through grade 12 that will orient curricular, teaching, and assessment efforts during the next decades." b) "Serve as a resource for teachers, education leaders, and policymakers to use in examining and improving the quality of mathematics instructional programs." c) "Guide the development of curriculum frameworks, assessments, and instructional materials." d) "Stimulate ideas and ongoing conversations at the national, state or provincial, and local levels about how best to help students gain a deep understanding of important mathematics" (NCTM, 2016, p. 2). Following the development of the PSSM, many states within the United States adjusted mathematics curriculum to include the four PSSM guidelines and identified the algebra course as a gatekeeper course for other mathematics and science courses in both high school and college (Greer, 2008; Murray, 2012). The curriculum content of the algebra course provides students a foundation of learning required to achieve positive performance in successive science and mathematics courses (Bryant & Bryant, 2016; Morgatto, 2008). Educational leaders advocate the content included in the algebra curriculum was pertinent to supporting student achievement in other mathematics courses like algebra II and geometry. Furthermore, the content learned in the algebra course was beneficial to student achievement in chemistry and physics. Both science courses include applications of algebra content (Greer, 2008; Morgatto, 2008; Murray, 2012).

The purpose for the Common Core State Standards was to provide high-quality learning within the classroom to meet targeted curriculum benchmarks for students in grades kindergarten to 12 (Council of Chief State School Officers, 2017; National Governors Association, 2010). The National Governors Association (2010) for algebra provide a set of standards for the knowledge students need to achieve to be successful in college. Algebra course teachers were expected to instruct students on each of the designated topic goals, and all high school algebra courses across the United States are strongly recommended to implement the High School: Algebra Common Core Standards. The goal of the Common Core State Standards was to ensure students successfully earn a high school diploma with the knowledge and skills to effectively excel in post-secondary training and employment (National Governors Association, 2010).

The compliance with the state learning standards along with the creation of a single high school plan for all types of student learners forced individual school districts to examine the methods they use in the school and classroom to help students graduate from high school (House, 2007). Alexander (2003) analyzed several high schools by looking at the ways the state had standardized the time-on-task (i.e., required amount of time per day and school year for each high school course) in required courses. For more than ninety years, the United States has used the Carnegie Units, an amount based on the time a student spends in school per each course as the criterion for awarding American students' academic credit. The goals for the measurement was to standardize the amount of instruction students received and the subject areas credited for college admission, and other purposes. Findings of the study showed students were exiting high school unprepared to meet proficiency in college-level mathematics classes and teachers were not provided adequate time to prepare all students to achieve proficiency in mathematics (Alexander, 2003). Alexander (2003) stressed the importance of standardizing the amount of instructional time-on-task to support student proficiency in a given academic course. In addition, Alexander (2003) discussed improving the amount of time-on-task for a course may support student proficiency in learning specific academic content.

Schools use the combination of both time-on-task and clearly identified state learning standards as required protocol for schools to deliver instruction required by mandates for a high school diploma. Learning standards are succinct descriptions of what students are expected to know at the conclusion of a course. These state learning standards include the Common Core State Standards. The requirement for all student learners to pass both required courses and their corresponding final state examination strengthened the need to improve the passing proficiency in algebra. The implementation of the high school diploma requirements and the learning standards for a specific, mandated course to be attained by all student learners was a challenge for teachers. The learning standards do not take into account students' past performance in prior courses and a student's current academic learning level. Requirements of time-on-task and specific academic content learning standards create a challenging situation for schools and teachers to create lessons in the allotment of required instructional time to successfully instruct students to learn, retain, and apply their knowledge to meet proficiency in the mandated final state examinations successfully.

In 2001, many states' educational leaders responded to NCLB (2001) and revised the requirements for a high school diploma. DeBray (2005) argued that in some cases the diploma requirements were implemented too quickly. DeBray (2005) examined only general education students required to attain algebra proficiency. The implementation of the updated diploma forced high schools to include all student learners in the algebra course. The schools' delivery of new requirements included (a) an increase from two to three mathematics and science courses, (b) a short amount of time for implementation, and (c) the increase of special education funding.

Additional mathematics and science courses. Several states' education departments in response to A *Nation at Risk* (U.S. National Commission on Excellence in Education, 1983) recommended changes to high school graduation diploma requirements which required more science and mathematics courses for students (California Department of Education, 2016; Connecticut Department of Education, 2016; Illinois State Board of Education, 2016; Massachusetts Department of Elementary and Secondary Education, 2016). Seven states implemented a policy for high school students to pass three mathematics and science courses in high school (Mehta, 2013). In Connecticut and California, algebra was a required mathematics course in addition to two more mathematics courses and three science courses for high school students to graduate from high school (California Department of Education, 2016; Connecticut Department of Education, 2016). One argument for increasing the number of students who take higher-level mathematics and science courses was to better prepare students for college (Allensworth, Nomi, & Society for Research on Educational Effectiveness, 2009; Dettelis, 2010; Teitelbaum, 2003). Teitelbaum (2003) examined how high school graduation requirements influenced college course selection. Findings from the National Educational Longitudinal Study (2016) indicated that when graduation requirements changed to include challenging mathematics and science courses, more students were prepared to take higher-level mathematics and science classes were prepared for college (Teitelbaum, 2003). Teitelbaum's (2003) study supported the movement for states' efforts to revise the graduation requirements to increase the number of mathematics and science content courses for high school students.

One state in the northeastern United States implemented the changes for requiring three science and mathematics courses for all high school students (SED, 2016b). One of the three mathematics courses high school students were required to pass was algebra. Teitelbaum (2003) studied grade nine students enrolled in an algebra course, regardless of their levels of achievement when the students were in middle school. Teitelbaum (2003) examined how the students' performance in the algebra course linked to student performance in other upper-level mathematics courses. Data from the National Educational Longitudinal Study (2016) examined 5,586 high school graduates. He used a multiple level regression analysis to explore how the increased rigor of an algebra course influenced the long-term success of students. Teitelbaum (2003) found that school districts, requiring three or more courses in mathematics and science, positively influenced the long-term student achievement in mathematics and science. The requirement for additional mathematics and science courses provided students with more experience in high school to practice and expand their knowledge in these content areas to be better prepared for the post-secondary courses.

In conclusion, external policies mandated that all students including SWD achieve algebra proficiency to graduate from high school, therefore, high schools from the identified state made changes with varying results.

Challenges Responding to External Policy

In response to national educational policies and legislation requiring students to take algebra in high school, state educational departments and local school districts needed to address the challenges to successfully implement the algebra requirement. Schools found they needed to expand their general mathematics education courses to include student learners who are attending high school and following an academic path for career readiness. Students not planning to attend a college or post-secondary training may not commonly enroll in rigorous academic, high school courses. Teachers of required courses had to instruct learners with different ability levels including SWD.

The challenge of requiring all student learners to pass algebra in response to external policies forced schools to consider the importance of learning standards, preparation time, and funding to provide effective instruction. Each of these key areas were necessary to successfully instruct students.

Preparation time. In response to NCLB (2001) the preparation time for many school districts across the United States was legislated to incorporate more science and mathematics courses (Wallis, 2008). The curriculum for required courses needed to support the corresponding state learning standards for the mathematics and science courses as final state assessment examinations were based on the state learning standards. Student performance on state examinations provided a measure of how effective a school was at instructing students in required content courses. State learning standards reflect the recommendations from the external policies pertaining to mandated content to be achieved (NCTM, 2016; NGA, 2010).

Educational leaders across the nation argued that the new testing policy timeline was implemented too quickly for teachers to adequately implement the newly required rigorous courses and assessments (DeBray, 2005; Wallis, 2008). Interviews with 177 school administrators and teachers from rural school districts in Maine and Missouri were included in the study to investigate if teachers were provided with enough instructional time and professional development training opportunities to improve test scores and meet the adequate yearly progress per NCLB (Powell, Higgins, Aram, & Freed, 2009). Teachers expressed the NCLB (2001) requirements of planning and learning effective teaching strategies was a challenge when time was not provided within the instructional day. During the interviews, one teacher explained, "Students are being tested to death but learning less" (Powell et al., 2009, p. 24). A second teacher explained, "They are just making children learn in order to pass tests but not for the good of learning" (Powell et al., 2009, p. 24). In another study about curriculum requirements, Alexander (2003) advocated a standardized diploma to include all general education students, but he stressed the need for adequate instructional time to support student success to meet the new high school diploma requirements. A source of information used to support his argument was the annual Basic Educational Data Systems (BEDS), which every New York State public schools' teacher, public school, and district must submit (Alexander, 2003). The BEDS include types of classes offered, number of students enrolled in each class section, frequencies and minutes of the class per school year, teacher experience levels, and school information on specific student populations. According to Alexander

(2003), the Personnel Master File and the Institutional Master File from the BEDS provided data about State Regents and State Local diplomas, core classes by their rigor of remedial, general, Regents and advanced provided to students. Findings of the study showed students were exiting high school not prepared to meet proficiency in college-level mathematics classes (Alexander, 2003).

Teachers state they were not provided with enough guidance and time to prepare lessons to instruct all student learners to achieve a high school diploma (DeBray, 2005). DeBray (2005) interviewed five mathematics teachers, eight English teachers, the school's assistant principal, and principal. Findings of the study showed actions (i.e., academic support outside of the classroom and improved lessons to improve student learning and retention) by both the administration and teachers to implement the state's curriculum and policy need to be improved to support the successful school learning environment. Each teacher interviewed indicated all of their classes contained students with varying levels of skills. Teachers and administrators explained, during their interviews, concern regarding the lack of consistent performance for students of low socio-economic backgrounds on the state mathematics and English examinations. One mathematics teacher stated, "the major weakness of my students is they can't process information" (DeBray, 2005, p. 27). A second mathematics teacher interviewed shared that there was a need for providing preparation time prior to the implementation of the new state course requirements. This planning time was necessary for a teacher to provide course content for all student learners effectively and not limit students from "their choices for a career when you are not properly preparing them in mathematics [to excel in both the course and final examination]" (DeBray, 2005, p. 30). Teachers from the mathematics and English departments discussed the actions (i.e., tutoring after school and reviewing foundational skills with students throughout the course) taken to support student proficiency in the required courses and examinations (DeBray, 2005). To best prepare students for successful learning outcomes, teachers voiced the need to have preparation time to evaluate course requirements (i.e., learning standards and content on the final state algebra examination) and provide opportunities within the course for students to experience the rigor and terminology used for final state assessment questions.

In Michigan, the Michigan Education Association (MEA) worried that without adequate preparation time to implement state education requirements, the mandated state assessments and requirements for courses would be harmful to minority students (Mehta, 2013). In addition to more preparation time, teachers need to be included in the decision for what types of student learners need to participate in required assessments (Mehta, 2013). MEA expressed concern for the teachers' need to have a greater input for "who will be assessed, when and on what and which assessment to use" (Mehta, 2013, p. 308). The Utah Education Association argued the idea of accountability and the need for preparation time to design curriculum to help all learners achieve positively in state educational requirements (Mehta, 2013). The amount of preparation time for teachers across the United States to successfully develop and implement curriculum to support criteria tested on required state assessments may not be adequate to promote positive proficiency for all student learners.

In conclusion, teachers expressed concerns regarding not enough preparation time to successfully design curriculum to prepare all student learners to achieve proficiency in required state education curriculum requirements. Preparation time for teachers is an essential component to develop and implement curriculum to support student proficiency in academic courses.

Funding. States across the United States increased funding for special education programs in response to federal legislation of NCLB (2001) and Individuals with Disabilities Education Act [IDEA] (2004). These policies supported the educational opportunities for SWD. Funding for states to implement the additional required curriculum courses was another challenge for schools. Districts' leadership immediately needed to budget for the new high school curriculum requirements. This included subsidizing the hiring of additional teaching staff to instruct the required curriculum. Larger costs associated with the requirements (i.e., increase in required courses) of the diploma were a direct burden on taxpayers within the school districts who could vote down the school district's budget if the proposed budget was too costly (Sipple, Killeen, & Monk, 2004). Sipple et al. (2004) examined individual school budgets and the role of superintendents to determine what interventions and capital resources to fund. Interviews with superintendents and other school administrators from six school districts responded to how the changing requirements changed the districts' budgets and program priorities to meet the new requirements better. One area within the field of special education impacted by the requirement of more mathematics and science courses was the shifting of funding for more co-teaching placements and a reduction of special education interventions (i.e., self-contained classrooms and Resource Room) (Sipple et al., 2004). More SWD were encouraged to enroll in general education co-taught mathematics and science courses.

Educational funding for special education was increased to fund co-teaching in response to both the change in high school diploma requirements for all student learners to enroll in required courses including the increase in the number of mathematics courses (Sipple et al., 2004). Analysis of the interview data revealed budgeted funding for special education was considerably increased to fund co-teaching (Sipple et al., 2004). School districts reduced student placements in the Resource Room to allow money to be spent on special educators to co-teach, a special education and a general education teacher jointly teaching a required high school education course. Special education funding was used to support SWD within the general education classroom using co-teaching. Co-teaching is a strategy to help both the general education students and SWD (Friend & Cook, 1996; Gagnon & Maccini, 2001, 2007). It is a strategy with both a general education teacher and a special education teacher sharing the delivery, organization, planning, and assessment of instruction within a classroom (Friend & Cook, 1996). The strategy of co-teaching allows the special education teachers to accommodate curriculum to help SWD to learn and process the concepts taught in the general education setting (Friend & Cook, 1996; Gagnon & Maccini, 2001). Implementation of co-teaching was with the required courses for high school graduation. Implementing co-teaching was an expense to school districts.

In conclusion, the policies raise challenges for school districts implementing the algebra requirement for high school students. As expressed by the studies, schools had to implement the required algebra course without needed preparation time to prepare and learn strategies to help student achieve proficiency in algebra; especially students who did not pass mathematics in middle school.

Policy Change and Factors

The National Mathematics Advisory Panel (NMAP) promotes the policy of having algebra as a required high school mathematics course (National Mathematics Advisory Panel, 2008). NMAP states the algebra course as developing "the critical skills and skill progressions for students to acquire competence in algebra and readiness for higher levels of mathematics" (Mathematical Association of America, 2008, p. 1). One study examined the importance for students to take high school algebra by interviewing school administrators and teachers, along with data from the National Educational Longitudinal Study (2016) of 1988 to 1992 from course placements of 10,046 of high school freshmen (Schiller and Muller, 2003). Students required to enroll in an algebra course as a ninth grader were more likely to continue to take more upper-level mathematics courses throughout high school, including advanced placement mathematics courses (Schiller & Muller, 2003). The requirement of the algebra course for high school students was advocated by national educational committees, in particular, the National Council of Teachers of Mathematics (National Council of Teachers of Mathematics, 2016). The National Council of Teachers of Mathematics (2016) expressed the algebra course has often been denoted as a gatekeeper course to advanced learning for mathematics and in other fields. Students who did not perform satisfactorily in the algebra course compromised their career options, especially in science, technology, engineering, and mathematics (STEM) fields (Gojak, 2013). Curriculum content instructed in the algebra course provided a foundation for students when taking additional mathematics and science courses. Gulick, a mathematics professor at the University of Maryland, stressed "Algebra is likely the first subject in which students develop logical thinking. It is also a place where students are exposed to abstract reasoning, and make decisions based on given information" (2012, p. 1).

Raising the bar for excellence in high school core courses was one rationale for requiring all student learners to accomplish the requirements for the revised rigorous high school diploma in the general education setting. High school leadership from many state school districts worked to improve course outcomes for all types of learners. Educational leadership across the nation in large part eliminated self-contained classrooms as a model of special education service delivery (Friend & Cook, 1996). Instead, many general education teachers instruct SWD in required general education courses, while collaborating with a special education teacher (Friend & Cook, 1996).

The collaboration of both course teachers includes developing, implementing, and grading assessments for the specific course. The Conceptual Framework (Figure 2.1) identifies instructional approaches as an important factor to consider when examining the impact of the potential problem for requiring all students to achieve proficiency in high school algebra, including SWD. The instructional approaches represent the algebra teachers (i.e., co-instruction by a general education mathematics teacher and a special education teacher) and the benefits and challenges algebra teachers experience instructing the algebra course. Both teachers are equal partners in the course they are instructing. The instructional strengths for a general education course with co-teachers may provide students with a stronger understanding of required course topics. Together the general education teacher and special education teacher can adjust lessons to best support student understanding and comprehension of the course. Providing collaborative instruction was an approach to improve course outcomes for all student learners to achieve the mandates of the revised state high school diploma.

Many SWD, were at a disadvantage because prior to algebra being a required course for graduation, those students were not guided to take challenging, college preparatory courses (Neild, 2009). This occurred because these students were prejudged not to be attending college (Finn, Gerber, & Wang, 2002; Neild, 2009). School leadership had to focus on instructional accommodations to remedy a need for support of mathematics results from middle school to get students, including SWD, to pass the algebra course and final state algebra examination (Daun-Barnett & St. John, 2012).

In grade nine, many states have both general education students and SWD enrolled in an algebra course (e.g., California Department of Education, 2016; Connecticut Department of Education, 2016; Illinois State Board of Education, 2016; Massachusetts Department of Elementary and Secondary Education, 2016; SED, 2016b). Educators of the algebra course need to produce lessons to promote learning to enable students to form meaningful connections with information learned to perform on course assignments and assessments successfully. In addition, algebra is a prerequisite of study for both high school and "college science courses, such as physics, chemistry, and biology, as well as computer science and engineering" (Gulick, 2012, p.1).

In summary, policy change and factors explained why it could be a problem to mandate all SWD to achieve proficiency in algebra. Algebra was promoted by the NCTM (2016) as a gatekeeper course to prepare students for other mathematics and science courses students will take in high school and college. High schools need to implement educational policies and research that demonstrate the merits of students taking algebra;

however, the struggle was providing an algebra course to students who are academically challenged with identified learning disabilities. The reduction of self-contained special education courses resulted in SWD enrolled in general education courses. The algebra course needs to provide an instructional setting to a range of learning abilities. Lastly, this demonstrated the problem of creating and implementing a required algebra course for students not having the prerequisite mathematics skills to attain algebra achievement. The algebra course needs to be developed and instructed to address the needs and levels of learners enrolled in the course.

Instructional Approaches

Instructional approaches implemented by course teachers should support student achievement of curriculum learning standards. The instructional delivery of required curriculum content by teachers is vital to promote the comprehension and mastery for students in academic courses, in particular mathematics. Teachers need to develop lessons to address the students' prior knowledge of curriculum content to introduce subject material for students to learn effectively.

Students enrolled in the course had different academic strengths, in which teachers needed to provide particular instructional approaches to support student achievement. Therefore, students' knowledge of previous subject area content provides direction for teachers to implement lessons to improve foundational areas in need of improvement to build on learning in a particular academic curriculum.

Student to teacher ratio. The number of students enrolled in each section of an academic course was an important element for teachers, guardians, and schools. Research over the past 35 years has examined the impact of the student to teacher ratio on student learning. A study by Glass and Smith (1978) examined 80 cases on the correlation between class size and achievement. This meta-analysis showed achievement increases and more learning benefits when the class size decreased to 20 students (Glass & Smith, 1978). One specific concern was class sizes with large student to teacher ratios did not provide adequate opportunities for students to be engaged in the classroom. Active engagement during instructional lessons allowed students to demonstrate proficiency and provides the teachers the opportunity to evaluate and provide meaningful feedback to each student about their academic performance (Glass & Smith, 1978).

The passage of IDEA (1997) mandated more SWD placed in general education courses. The result was the implementation of co-teaching in general education courses (Gagnon & Maccini, 2001, 2007). Many educational leaders, individual school districts, and teachers advocate for smaller class sizes. They see the advantages for not putting into action academic courses with large student enrollment (Ellerbrock & Kiefer, 2013). The requirement for all students to take the algebra course resulted in larger enrollment in algebra course sections being co-taught across many states. Additional funding from the state and school districts were needed to reduce the class sizes to accommodate all general education students and SWD enrolled in the algebra course. Ellerbrock and Kiefer (2013) collected data from two schools with similar student demographic information (i.e., socio-economic, race, ethnicity). Large class enrollments included a population of 557 grade nine students. The researchers examined the correlation between students' scores in high school and middle school course selection with class size. The researchers studied 56 students enrolled in smaller class sizes with a co-teaching approach for algebra including other core courses for grade nine. These students showed greater improvement in academic courses compared to students in large class sizes without co-teaching. Co-teaching allowed teachers to provide more individual attention to students. The study supported the implementation of smaller classes and teaming in schools (Ellerbrock & Kiefer, 2013). Small student to teacher ratios for academic courses provided more opportunities during the course for teachers to understand each student's learning ability to help improve and strengthen student learning in a specific course.

Algebra teachers. Course teachers must develop and implement lessons from required curriculum learning standards to prepare all student learners to achieve a passing score on the final state assessment and course. The general education mathematics teachers had the challenging task of including SWD and helping these students achieve proficiency (Foegen, 2008; Foegen, Olson, & Impecoven-Lind, 2008). Eighteen general education algebra teachers in three high schools participated in a survey to share the challenges for instructing SWD (Foegen, 2008). These teachers expressed a desire to receive professional learning and time to develop an algebra curriculum to meet the learning process of SWD. The teachers discussed the need for professional learning opportunities for the mathematics curriculum (i.e., algebra, trigonometry, and geometry) they co-taught (Foegen et al., 2008). The teachers stated they were not provided with enough professional learning opportunities on mathematics content to successfully co-teach the general education course and accommodate the curriculum for struggling learners (Foegen et al., 2008).

In summary, instructional approaches explained the problem for mandating proficiency in high school algebra for SWD. Large student enrollment in the algebra course made it a challenge for teachers to improve student comprehension of algebraic concepts. Teachers need to communicate with individual students during the algebra course lessons to monitor student understanding and to make changes to support student comprehension. Professional development opportunities need to be offered to the algebra course teachers to learn instructional strategies to help all student learners achieve algebra achievement.

Algebra Achievement for Students with a Disability

Today, more enrolled students are in high school algebra including an increase in enrollment from SWD. The changes made to federal education policies to include NCLB (2001) have encouraged SWD to pursue more rigorous academic courses in a general education setting.

Prior to NCLB (2001), many SWD primarily enrolled in academic courses provided within a self-contained special education setting (Idol, 2006; Jones & Hensley, 2012; Steele, 2010). The increase of SWD enrolled in general education course settings required courses to incorporate accommodations in each student's individual education plan (IEP).

Response to Intervention. Response to Intervention (RTI) is a multi-tier educational methodology to identify and support student learning. The first step in the RTI process is high-quality instruction and universal screening for students in the general education classroom. Students who are not consistently successful learners are provided with preventative educational help to improve their learning. RTI is provided in the school setting by general education teachers, special educators, and other specialists (e.g., psychologist, counselor). Student growth is frequently examined to determine the appropriate level and rate of performance. The length and intensity for the educational intervention are centered on each student's progress (Center on Response to Intervention at American Institutes for Research, 2017; Fuchs & Fuchs, 2006; RTI Action Network, 2017).

The required components for RTI to be successful include: Ongoing student assessment, tiered instruction, high-quality classroom instruction, and guardian engagement (Center on Response to Intervention at American Institutes for Research, 2017; Fuchs & Fuchs, 2006; RTI Action Network, 2017). RTI uses ongoing student assessment to examine student achievement to determine if a student required additional instructional opportunities to increase comprehension. The purpose of the ongoing assessment was to evaluate the needs of each student and to identify students who needed additional academic support. Tiered instruction provides instruction to students by increasing the level of intensity specific to the learning needs of each student. The three tiers are Tier 1: High-Quality Classroom Instruction, Screening, and Group Interventions, Tier 2: Targeted Interventions, and Tier 3: Intensive Interventions and Comprehensive Evaluation (Center on Response to Intervention at American Institutes for Research, 2017; RTI Action Network, 2017). High-quality classroom instruction for all students in the general education classroom setting needs to include evidence-based practices (EBP). An evidence-based practice is an instructional strategy, intervention, or teaching program to produce successful academic findings when tested experimentally (Mesibov & Shea, 2011; Simpson, 2005). Guardian engagement is the school providing information about a student's progress, information pertaining to the interventions being implemented, and goals developed to support the student achievement. Guardians need to be informed and consulted about goals and suggestions to improve student achievement in school (Fuchs

& Fuchs, 2006; RTI Action Network, 2017). RTI is a school-wide structure for properly distributing resources to improve student academic performance (Fuchs & Fuchs, 2006; RTI Action Network, 2017). RTI is needed to give students, academic support to achieve proficiency in content courses, especially algebra. RTI helps students who need extra time to relearn and reinforce content being instructed in the algebra course.

Intervention sessions. Providing time within the school day to provide academic support is necessary to help students comprehend and attain competence in each course. The rigor, pace, and the individual students' learning aptitudes were all elements that can impact the need to provide students with an intervention session. Many SWD have mathematics and reading levels two to three years below their current grade level (Mulcahy, Maccini, Wright, & Miller, 2014). Insufficient knowledge of mathematical concepts and need of additional support for skills in reading comprehension could explain why many SWD had difficulty processing and solving multiple-step word problems in the algebra course (Maccini, McNaughton, & Ruhl, 1999). Intervention sessions were necessary to provide academic support to SWD in middle school to meet proficiency in mathematics (Powell, Fuchs, & Fuchs, 2013). The study's finding explained student performance might be improved with the consistent use of the IEP's student testing accommodations specifically to include reading the test to the student, more time to complete a task, and use of a calculator for mathematics and science course. The IEP test accommodations were necessary and mandated per the IEP to support student academic achievement.

Instructional intervention opportunities (i.e., Resource Room and after-school help) in addition to the algebra course instructional time are helpful for increasing student proficiency in algebra. The Resource Room designation characterizes a special education pull-out intervention placement provided by a special education teacher in a self-contained classroom with an approximate number of five SWD for one class period per day outside of the general education setting. The teacher's job in the Resource Room setting is communicating with each of the students' general education teachers to be informed of current student progress, course assignments, and course curriculum topics being instructed is the responsibility of the Resource Room teacher.

Balfanz and Byrnes (2006) analyzed reasons why students had difficulty succeeding in high school mathematics classes and explained why some students in middle school were failing and not ready for the rigorous mathematics courses in high school. Balfanz and Byrnes identified additional instructional support influenced positive performance in mathematics. The study examined the impact of making structural changes in three of the 23 urban middle schools in the School District of Philadelphia. Changes made in these three schools entailed improved instructional interventions opportunities (i.e., Resource Room and after school help), and in-service learning for teachers. The results indicated when changes were implemented, the gap amongst SWD and general education in mathematics decreased. Small groups of instructional interventions opportunities (i.e., Resource Room and after school remediation) provided additional academic help for students identified as needing additional academic support opportunities in school (Balfanz & Byrnes, 2006; Idol, 2006).

One study explored opportunities for algebra instructional interventions of high school students classified as special education (Powell et al., 2013). The study examined if providing instructional interventions three days a week, would support SWD learn mathematics. Powell et al. (2013) explained how the need for additional support for mathematics skills influenced performance levels in the algebra course. Students were given a pretest before and after the instructional interventions. The instructional intervention was small group tutoring for 18 weeks with 35 students to focus on number concepts, including algebra expressions and transformations (Fuchs, Seethaler, Powell, Fuchs, Hamlett, & Fletcher, 2008). Findings supported instructional interventions to improve student performance in mathematics. Furthermore, a designated time and course to work with students who have a disability during the school day to reteach the concepts taught in algebra was vital in Powell et al.'s (2013) study.

The examination of how SWD were supported in the general education classroom setting and the types of services made available to these students was the focus of one study (Idol, 2006). For the study, eight schools (i.e., four elementary and four secondary) implemented instructional intervention strategies (i.e., consultant teacher, instructional assistants and teacher assistance teams) to support SWD in a general education setting. The study included 125 interviews with school administrators, general, and special education teachers. Only two participants interviewed thought SWD should be instructed in self-contained classrooms and not in the general education setting. Teachers reported many general education students benefitted from the support of special education teachers collaborating in the general education classroom. Interview results provided recommendations from the staff to improve and maintain academic achievement for SWD. These recommendations were to provide support in an intensive instructional setting using the curriculum from the general education courses and using the teacher to consult with the general education teacher to be informed of instructional support needed by SWD. The findings supported the benefit of providing supports, such as an IEP placement of the Resource Room, to offer additional instructional interventions and reinstruction opportunities for SWD (Idol, 2006). The Resource Room teacher used the course period to provide additional instructional support (i.e., reinstruct course curriculum, homework, and projects), testing accommodations, and to implement achievement testing. Some districts moved away from a small Resource Room placement with five students or less to a learning skills class to include as many as 18 students per class due to resource reduction. Conclusions indicated smaller teacher-student ratios with reinstruction of academic courses delivered in a Resource Room setting improved academic proficiency in general education courses (Idol, 2006; Vannest, Hagan-Burke, Parker, Soares, 2011; Wilson, Kim, & Michaels, 2011).

Accommodations. Accommodations are any changes made to tests or testing conditions that allow SWD to demonstrate their knowledge and skills in an academic area. The accommodations permit SWD to use testing and curriculum accommodations in academic courses required by both the NCLB (2001) and IDEA (1997). The purpose of the accommodations is to show the accurate growth for each student on academic content standards. Accommodations for SWD include testing accommodations (i.e., separate location, having the test read to them) and curriculum accommodations (i.e., complete fewer or different homework problems).

Along with providing resources for additional instructional interventions to support comprehension of curriculum, each student with a disability who had testing accommodations included in their IEP for the algebra course and the final state algebra examination need to use their testing accommodations for all course examinations. The most frequent testing accommodations for an algebra examination were use of calculator, separate location, extended time, and having someone read the test for the student. The testing accommodations were a necessary way to support SWD to be provided with needed additional support (i.e., reading comprehension and mathematic computations) to meet proficiency in courses and on tests (Maccini & Hughes, 2000).

Teachers should provide opportunities for additional academic support to improve student comprehension of course curriculum. Bruning (2011) emphasized, “Extended practice is needed to develop cognitive skills” (p. 6) and the need to provide opportunities for “repetition and practice in helping students increase their cognitive capabilities” (p. 7). A daily period of intervention instruction may help SWD who need the additional support to achieve in the general education courses. The Least Restrictive Environment (LRE) Policy under the law of Individuals with Disabilities Education Act (2004) increased the number of SWD into a general education placement. To support the instruction of curriculum in the general education setting, opportunities for small group interventional instruction is needed to provide academic support. Cognitive theorists emphasize the importance of “extended practice is needed to develop cognitive skills” (Bruning et al., 2011, p. 6; Flavell, 1979). The “need for repetition and practice in helping our students increase their cognitive capabilities” can be delivered by school instructional intervention support opportunities of after-school help and in the intervention settings (Bruning et al., 2011, p. 7; Schunk, 2008).

Discussion and Conclusion

Research supports high school algebra is challenging for many students including SWD to achieve (Bruning et al., 2011; National Mathematics Advisory Panel, 2008).

Introduction of the requirement of a high school algebra course might negatively influence high school completion rates for SWD. Requiring algebra for graduation might force high school leadership to re-examine instructional and testing accommodations necessary to support students adequately with a disability.

Across the nation, schools have been grappling with the best approach to improve student algebra achievement. Some schools in Illinois were pushing for grade eight students to take algebra to get students prepared for more challenging math courses students need to take in high school (Chicago Tribune, 2015). One Illinois school district was providing an additional period of algebra to improve the passing rate for the algebra course (Chicago, Tribune, 2015). Another suggestion a Florida teacher used to support student achievement in algebra is to record all the lessons on the internet for the students to view to understand the different algebra computations (State Impact, 2014). The challenges associated with the high school algebra policy requirement included whether educational leadership could structure an algebra course to help SWD who struggle with mathematics concepts achieve algebra proficiency. Based on this information, one must question: What accommodations need to be considered to help SWD pass the algebra course and final state algebra examination requirement? Does middle school student performance on mathematics assessments correlate with outcomes in high school algebra? Each of these questions needs to be carefully considered when developing and implementing an algebra course to improve the passing performance for SWD on the final state algebra examination.

In summary, the review of literature identified external educational policies and underlying causes that explored the rationale for making algebra be a mandated high school mathematics course requirement. The external state policies forced high schools across the nation to increase the number of high school mathematics courses. State-wide mathematic curriculum for schools encountered challenges when it was mandated both general education and SWD enroll and achieve proficiency in algebra. Many schools and teachers expressed not enough preparation time was provided to effectively develop and implement the algebra course for a broad range of student learners. In addition, funding to create additional sections of the algebra course to include both general education and SWD was an expense for schools. Algebra courses needed to accommodate SWD and create co-taught sections of the algebra course to meet the mandates of the students' IEPs. Also, to meet the high school graduation diploma requirement for all student learners to pass algebra, specific instructional interventions are necessary to support student achievement.

The goal of chapter two was to identify and examine the problem of requiring SWD to pass algebra to graduate from high school. Chapter two illuminated the policies that impacted the required course, how instruction is being implemented, and how students are getting support to meet the demands of the rigorous high school diploma mandates. In the next chapter, the Grade Eight State Mathematics Assessment results were examined to determine if a relationship exists between students who fail the grade eight final state mathematics examination and fail the algebra examination. Studying student final test scores in grade nine algebra and grade eight mathematics will determine the statistically significant impact for requiring passing algebra for SWD. In summary, the results from the literature review will reinforce the challenges of mandating all student learners pass the final state algebra examination to graduate from high school.

Chapter 3. Needs Assessment

The review of literature demonstrated the educational policy rationale and challenges for requiring students to take algebra in high school. Factors of instructional approaches and instructional setting can positively impact student performance in algebra. For SWD enrolled in the algebra course both curriculum and testing accommodations along with the support of additional instructional interventions are important to improve proficiency.

The purpose of the mixed methods needs assessment was to confirm if students' performance on the Grades Seven and Eight State Mathematics Assessments show a relationship of performance on the state final algebra examination. The objective for chapter three was the development of the mixed methods needs assessment to determine if middle school performance on state assessments has a relationship with students' performance on the final state algebra examination. The needs assessment examined the quantitative data of student performance on the Grades Seven and Eight State Mathematics Assessments and the final state algebra examination for earning a high school diploma. Qualitative data included teacher interviews to provide details about the high school algebra course and student performance in the algebra course.

Research Questions

This section includes four research questions to examine the potential problem for changing the high school graduation requirements for SWD. The purpose of each research question was to collect data to analyze if there was a relationship between the outcomes on the grade eight mathematics assessment and the grade nine final state algebra examination.

- RQ1: What is the association between education classification (General Education, Special Education) and performance on the Grades Seven and Eight State Mathematics Assessment?
- RQ2: What is the association between education classification (General Education, Special Education) and performance on the final state algebra examination?
- RQ3: What is the association between education classification (General Education, Special Education) and receiving a State Regents Diploma?
- RQ4: What is the association between the percentages of (General Education, Special Education) grade eight students who passed the Grade Eight State Mathematics Assessment and the percentages of high school (General Education, Special Education) students who passed the final state algebra examination?

Method

A mixed method research design were used to inform this needs assessment study (Creswell & Clark, 2011; Teddlie & Yu, 2007). The quantitative data was collected and then analyzed for statistical significance for each of the research questions. Research Questions One, Two, and Three were analyzed with a chi-square test of independence. Research Question Four was analyzed using an independent samples *t*-test to examine the findings for the association between the percentages of grade eight students who passed the Grade Eight State Mathematics Assessment and the percentages of high school students who passed the final state algebra examination. Findings from the quantitative data were used to design the teacher interview questions to provide more details about the student learning in algebra. The use of qualitative data was to provide more clarity and to elaborate on the findings from the quantitative data findings to provide a more detailed explanation about the problem of practice (Creswell & Clark, 2012).

Collection of Testing Data for Research Questions

Participants

The following represent the key participants in this study:

1. Grade nine students who took the final state algebra examination.
2. Grade seven students who took the Grade Seven State Mathematics Assessment.
3. Grade eight students who took the Grade Eight State Mathematics Assessment.
4. The students and teachers from two high schools and three middle schools in the identified school district.

The participants from the study were from a northeastern state located in the United States. The identified school district was a suburban school district with 15% of the student population in each school included SWD, and 75% of the student population received free or reduced meals (i.e., breakfast and lunch). Demographically, 70% of the student population is White, 27% is Black, and 3% is a combination of other ethnic backgrounds (SED, 2016c).

The collection of data from instruments included student test scores on state mathematic assessments for grades seven and eight, and the grade nine final state algebra examination. School districts implemented the required curriculum and examinations mandated by the state education department. Each district was tasked to create a grade nine algebra course to provide results of 100% proficiency on both the algebra course grade of a minimum of 65 and the state standardized examination score of a minimum of 65. Students' results from the examination influence the school's and district's success on the school district's state report card. All schools and school districts across the state were compared to other schools and districts in the state using the state education department's annual report card. Yearly report cards for each school and district were available to view on the State Education Department's website (SED, 2016c) where prospective students and homebuyers can view the data to determine where to live and send their children to school. The pressure for schools to perform well on state assessments, and ultimately on their school and district report card, is essential for the school and its surrounding community.

Data Collected

Data collected from students who participated on the Grades Seven and Eight State Mathematics Assessments and grade nine state final algebra examination were analyzed. The test results consisted of 8,688 students' scores from Grades Seven and Eight State Mathematics Assessment. For grade seven, 3,534 general education students and 784 SWD from three middle schools in the identified school district participated in the Grade Seven State Mathematics Assessment from 2006 to 2012. The student samples were not equal across the years with the precise number of participants, but each year had approximately the same number of students who participated on the examinations. The Grade Eight State Mathematics Assessment at the identified school district's three middle schools had 4,370 students take the examination between 2006 and 2012; 798 of the student participants had a disability, and 3,572 were general education students. On the final state algebra examination from 2006 to 2016, a total of 4,448 students took the examination from the two high schools in the identified school district; 3,483 general education students, and 965 SWD. Regents Diploma graduates from the identified two high schools from the identified school district was 3,747 from 2006 to 2012. General education students earning a Regents Diploma was 3,389 and 358 SWD earned this type of high school diploma from 2006 to 2012. Three high school teachers were interviewed to provide details about student algebra achievement and meeting the mandates for earning a Regents Diploma. All of the data collected were from the same suburban school district within one state.

Middle school data from participants. Middle school data included all students' test scores from grades seven and eight who took the standardized Grades Seven and Eight State Mathematics Assessment from 2006 to 2012, which is given yearly to all students enrolled in those grade levels. The middle school data were collected from three middle schools in a single school district's Office of Accountability and the SED (2016c) website. Information from each of the assessment results identified the total number of students who took the examination and how many of the students passed the examination for a specific school year. Additionally, the data represented the number of SWD and general education students who participated in the examination, and the passing rate of each school year.

High school data from participants. High school data included all test scores from students who took the final state algebra examination from 2006 to 2012. The data showed how many students participated in the standardized algebra examination and how many of those students passed the examination in a specific academic year. Other data shared included the number of SWD and general education students who took the standardized algebra examination, and how many of those students passed in a given school year.

The testing data were from two high schools located in the same school district. The high school data was collected from the same school district in which the researcher collected and evaluated middle school test scores. The method to obtain the information came from the SED (2016c) website and the Office of Accountability from the identified school district.

The data compared to the same cohort performance on the final state algebra examination to assess if students' Grade Eight State Mathematics Assessment scores had a relationship with the students' performance on the final state algebra examination. Data from these assessments were posted for every school in the state (SED, 2016c). Additional data examined included the number of general and special education high school graduates who earned Regents Diplomas over a seven-year period in the school district being studied.

Instruments

Measurement devices used for the needs assessment to collect data were the Grades Seven and Eight State Mathematics Assessment, final state algebra examination, and high school diplomas. Each instrument was used by the researcher to measure variables for the data collection of the needs assessment. Each instrument supported the researcher to examine the performance of both general education students and SWD from one school district.

The collection of data used each of the four instruments to provide information to answer each of the four research questions and four hypotheses for the needs assessment. The instruments enabled the researcher to collect data and determine outcomes for the problem of practice of a required high school diploma requiring all student learners to pass algebra. Data findings from using the identified instruments provided guidance about a potential intervention to improve SWD proficiency in algebra.

Grade Seven State Mathematics Assessment. The Grade Seven State Mathematics Assessment includes a two day, timed, state, standardized assessment given during the first week of May, scored by trained, non-course teachers. On day one, students have 60 minutes to answer 30 multiple-choice questions. On the second day, students have 55 minutes to answer four short response questions and four extended response questions. Appendix C provides three example questions for the Grade Seven State Mathematics Assessment.

Data from the Grade Seven State Mathematics Assessment (Figure 3.1) showed a relationship between the test score results for SWD compared to the test score results for general education students on the Grade Seven State Mathematics Assessment from 2006 to 2012. Data used to complete the graph (Appendix D) showed the yearly information included:

- How many general education (GE) students took the examination?
- How many SWD took the examination?
- How many general education (GE) students passed the examination?
- How many SWD passed the examination?

In Grade Seven State Mathematics Assessment (Figure 3.1), the number of both general education and SWD who took the Grade Seven Mathematics Assessment from 2006 to 2012 are represented in the figure.

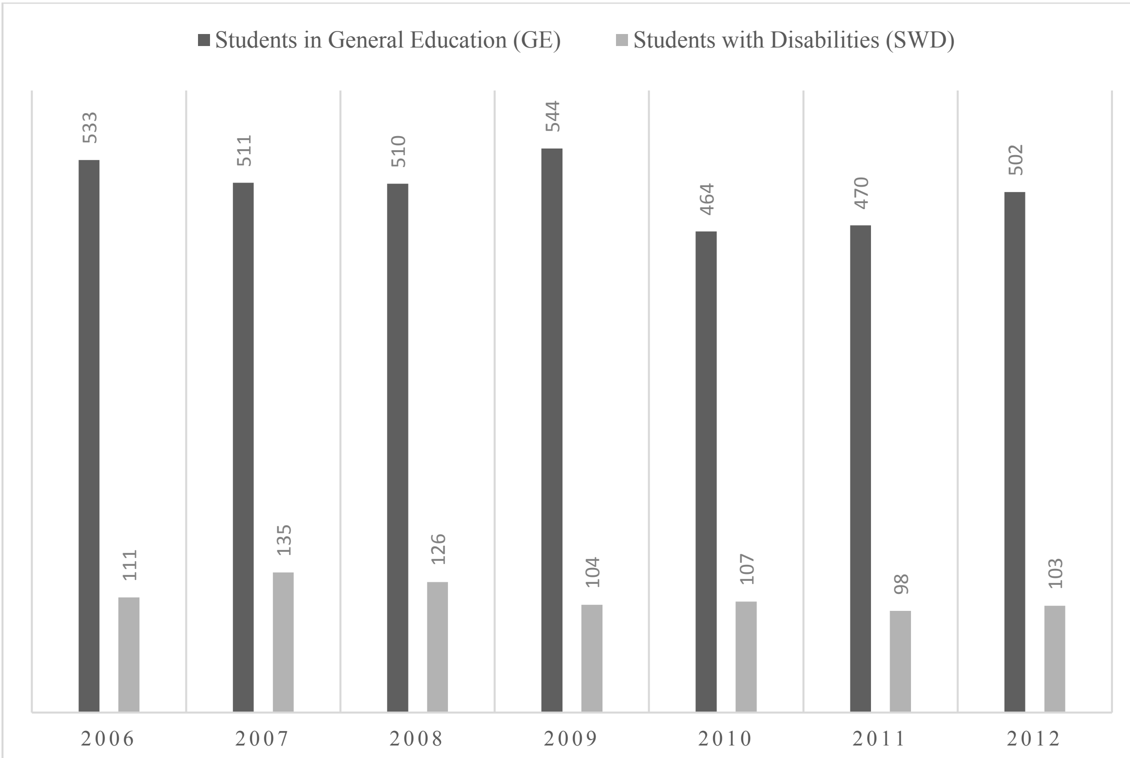

Figure 3.1. Student participants for the Grade Seven State Mathematics Assessment.

Grade Eight State Mathematics Assessment. The Grade Eight State Mathematics Assessment is similar in format to the Grade Seven State Mathematics Assessment, with the exception of content included in the state mandated general mathematics curriculum grade eight. On day one, students have 90 minutes to answer 27 multiple-choice questions, four short response questions, and two extended response questions. On day two, students have 70 minutes to answer eight short response questions and eight extended response questions. Appendix E provides sample assessment questions given for students to solve for the Grade Eight Mathematics Assessment.

Content questions on the assessment were developed by teachers to re-enforce the mandated state mathematics curriculum for all grade eight students. Data (Appendix F) showed yearly information including:

- How many general education (GE) students took the examination?
- How many SWD participated on the examination?
- How many general education (GE) students passed the examination?
- How many SWD passed the examination?

Data included on the Grade Eight State Mathematics Assessment (Figure 3.2) illustrates the number of both students in general education and SWD who took the Grade Eight Mathematics Assessment from 2006 to 2012.

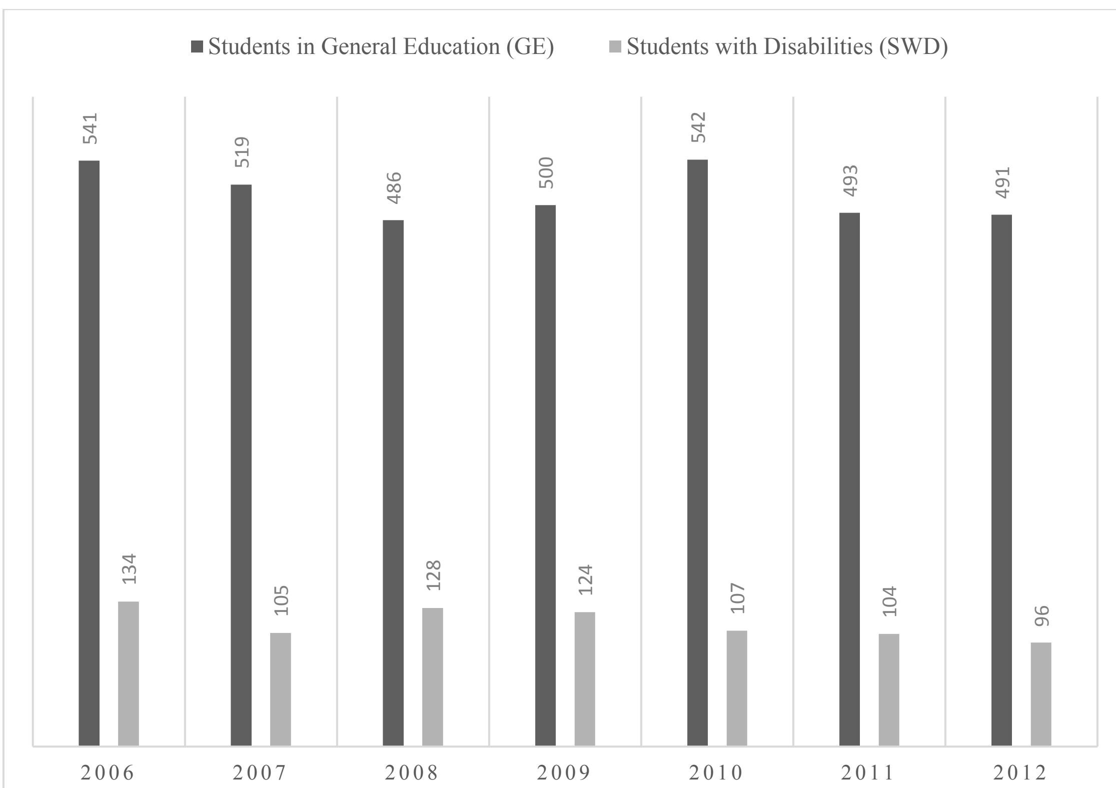

Figure 3.2. Student participants for the Grade Eight State Mathematics Assessment.

Final State Algebra Examination. The final state algebra examination is a 3-hour state, standardized assessment and scored by teachers who were not the teachers of the students enrolled in the teacher's course. The examination's format contains four sections, and questions one through 26 are multiple choice questions, and 27 to 38 are open response word problems. Appendix G provides three sample examination questions for students to solve and answer. Data showed similar results for SWD compared to all students on the final state algebra examination from 2006 to 2012. Data (Appendix H) showed yearly information to include:

- How many general education (GE) and SWD participated in the examination?
- How many general education (GE) and SWD students passed the examination?
- How many general education (GE) and SWD students earned a Regents Diploma?

The data from the State Regents Algebra Examination (Figure 3.3) represents the number of both general education and SWD who took the final state algebra examination from 2006 to 2012.

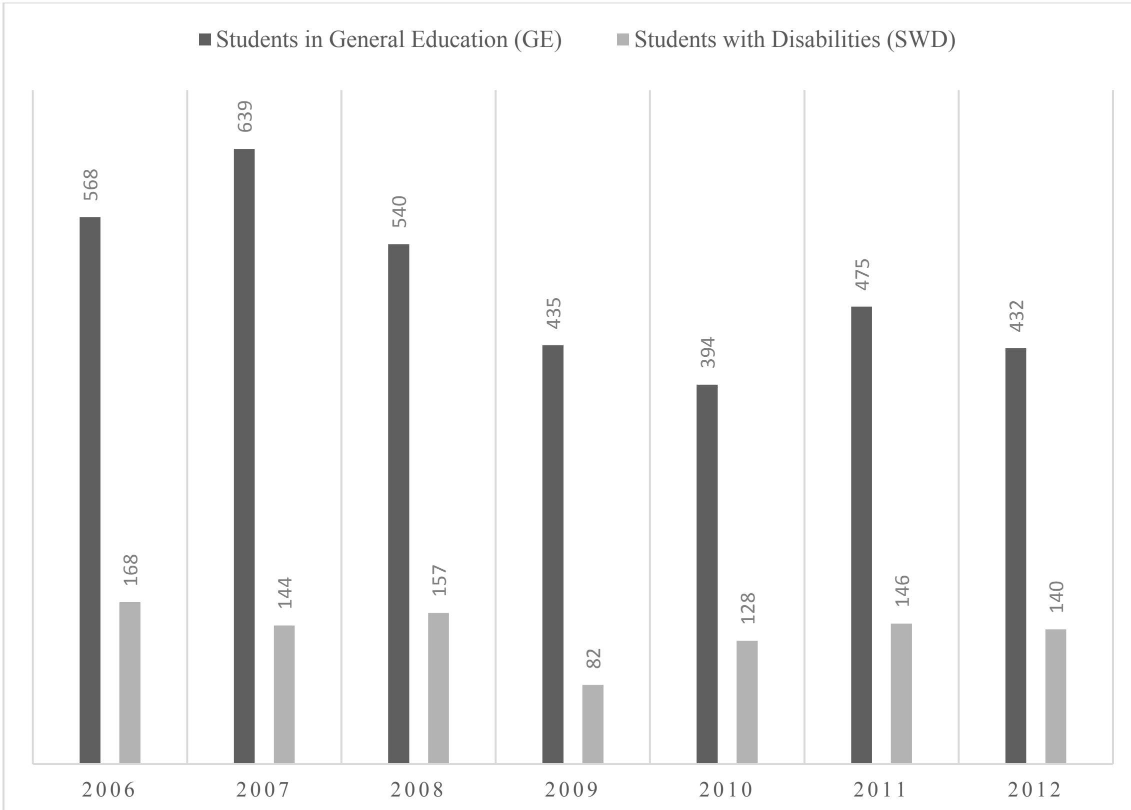

Figure 3.3. Student participants for the State Regents Algebra Examination.

In summary, quantitative data collection along with the factors from the literature review was used to develop interview questions to provide greater insight about the performance for SWD and proficiency in algebra. The literature review discussed challenges with the rigorous academic curriculum and the policy for all student learners to achieve to graduate from high school (DeBray, 2005). The total number who took the examination every year from both high schools from 2006 to 2012 was 4,448 students. A chi-square test of independence was used to measure the overall passing percentage for each of the years from 2006 to 2012 the assessment was examined for the needs assessment.

The chi-square test of independence statistical analysis test is generally used for testing relationships between categorical variables. The statistical analysis test assesses whether an association exists between the two variables by comparing the observed relationship of responses to the pattern would be expected if the variables were strictly independent of each other. The rationale for using the chi-square test of independence is to determine if the overall percent of passing performance for students each year (i.e., 2006 to 2012) shows a relationship between the variables.

To test the hypothesis, a chi-square test of independence was used to analyze each categorical variable to find the association for the overall passing percentage for students' scores for each school year. The data provided included the overall passing percentages of student performance and not individual student test scores to examine student performance. Additionally, to test the fourth hypothesis, an independent samples *t*-test was performed using the Grade Eight State Mathematics Assessment scores from 2006 to 2012 and final state algebra examination scores from 2006 to 2012.

High school diploma. The State Regents Diploma is a rigorous state high school diploma that requires the proficiency in core academic courses and their corresponding state final examinations. Students are required to pass four years of social studies (i.e., World History 1, World History II, American History, Economics, and Government), and English, and three years of mathematics (e.g., Algebra) and science (i.e., Earth Science and Biology). In addition to the core courses, students are required to take an art or music course, an elective sequence, and physical education. The collection of data examined the number of student learners earning the rigorous State Regents High School Diploma. The State Regents Diplomas (Figure 3.4) illustrates the number of both students in general education and SWD who graduated from high school with a State Regents Diploma from 2006 to 2012.

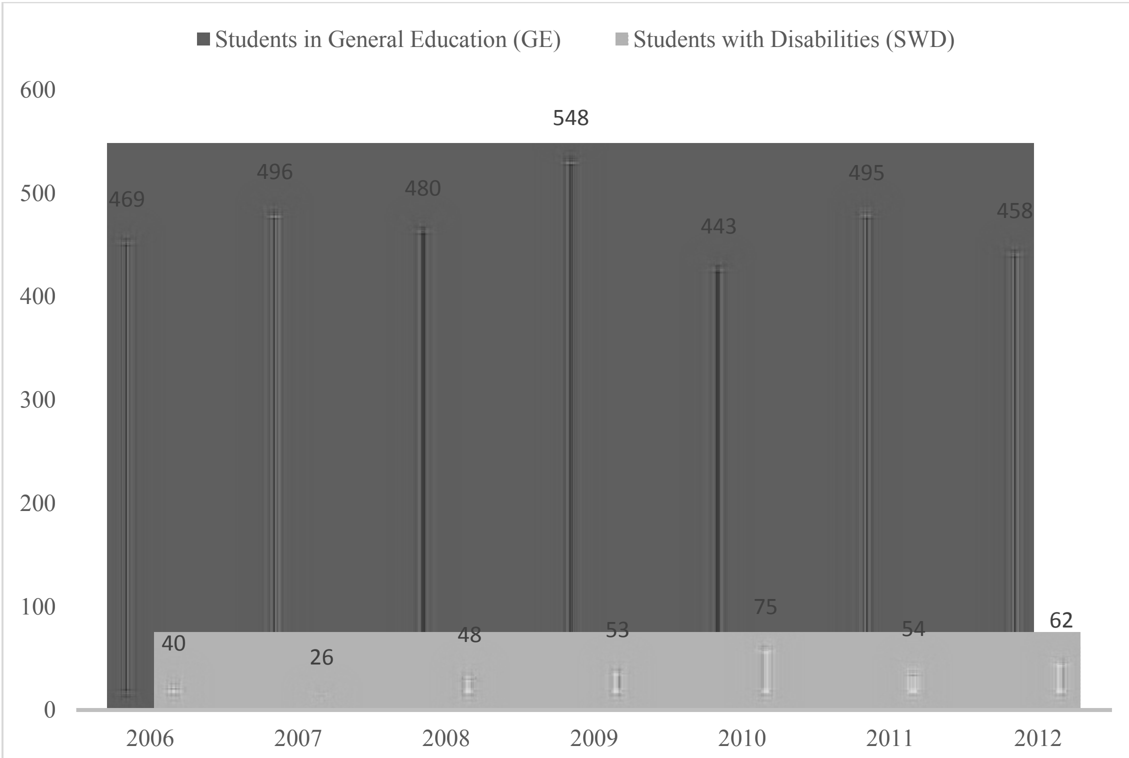

Figure 3.4. State Regents Diplomas for student participants.

In summary, the total number of 8,688 students took the Grades Seven and Eight State Mathematics Assessments from one of the three middle schools from 2006 to 2012. The total number of students who took the final state algebra examination from two high schools within the same school district from 2006 to 2012 was 4,448, and 3,747 students graduated with a Regents Diploma from 2006 to 2012 from one school district. After the data collection, the scores were used along with information gathered from the review of literature to create interview questions. To test the hypothesis, a chi-square test of independence was used to analyze each variable.

Collection of Data from Teacher Interviews

The data collection included qualitative interviews with three high school teachers who implemented the new graduation requirements about the new change impacting their SWD success in algebra. Questions for each of the three interviews established how and why each of these respondents believed the new graduation requirements influenced SWD. The goal for the interviews was for each person to discuss reasons why SWD might have struggled in algebra, if middle school grades were a correlation to algebra proficiency, and if elements of the algebra course might negatively hinder SWD performance.

Participants

Interviews were conducted with the following people:

- General education mathematics teacher who has been teaching algebra and grade eight mathematics for more than 15 years, and has been co-teaching algebra with a special education teacher for more than six years.
- Special education mathematics teacher who has been teaching special education for more than 10 years, and has been co-teaching algebra with a general education teacher for over six years.
- Special education teacher who has been teaching SWD for over 25 years, and has worked closely with instructing SWD enrolled in algebra.

Prior to the interview, each of the three teachers was given a copy of the consent form (Appendix A) to review and sign prior to the interview session. Teachers answered eight questions created by the researcher (Appendix B) relating to the study's variables.

Procedure

This section discusses the components of the intervention to include the data collection, and data analysis for the needs assessment.

Research Question 1

What is the association between students' education classification (General Education, Special Education) and performance on the Grades Seven and Eight State Mathematics Assessment?

Hypothesis 1

SWD will have a lower passing rate than the general education students on the Grades Seven and Eight State Mathematics Assessment.

The dependent variables were the Grades Seven and Eight State Mathematics Assessment scores. The independent variables were the groups of SWD and general education students who participated in the Grades Seven and Eight State Mathematics Assessment. Test results for the Grades Seven and Eight State Mathematics Assessments were studied to show how general education students and SWD performed on the Grades Seven and Eight State Mathematics Assessments.

Teacher participants interviewed were asked to share their thoughts on using cut scores from the results of the Grades Seven and Eight State Mathematics Assessments to identify students who might be challenged by the grade nine algebra course. Data from 2006 to 2012 from three middle schools in the same school district were used (SED, 2016c). One interview question aligned to Research Question 1 that represents the variables used for the teacher interviews includes:

1. What scores (i.e., failing, below 65) on the Grades Seven and Eight State Mathematics Assessment should be used to identify students who might have difficulty with the grade nine algebra course and examination?

Research Question 2

What is the association between student group classification (General Education, Special Education) and performance on the final state algebra examination?

Hypothesis 2

SWD will have a lower passing rate than the general education students on the final state algebra examination.

The dependent variable was the final state algebra examination scores. The independent variables were SWD and general education students. Test results for the final state algebra examination were studied to show how general education and SWD each performed on the assessment. Data from two high schools within the same school district from 2006 to 2012 were used (SED, 2016c). Below are the interview questions aligned to Research Question 2 that represent the variables used for the teacher interviews include:

1. In general, what elements about the algebra course framework commonly give the SWD difficulty?
2. What are three learning skills SWD do not exhibit in algebra class that contributes to their lack of success?
3. What support systems outside of the algebra course are beneficial to help SWD meet proficiency in algebra?

4. When SWD fail the algebra course and examination are they more successful at the second attempt?

Research Question 3

What is the association between education classification (General Education, Special Education) and receiving a State Regents Diploma?

Hypothesis 3

SWD will have a lower graduation rate than the general education students in earning a State Regents Diploma.

The dependent variables were the State Regents High School Diploma and the Local High School Diploma. The independent variables were SWD and general education students getting a State Regents High School Diploma (i.e., general education students are not eligible for the State Local High School Diploma). In addition, collection of data included the number of SWD earning a State Local High School Diploma. General education students were not eligible for the State Regents High School Diploma (SED, 2016c).

State Regents High School Diploma results for students were studied to show how many general education and SWD each earned the State Regents High School Diploma. Data from two high schools within the same school district from 2006 to 2012 were used (SED, 2016c). The following interview questions aligned to Research Question 3 that represent the variables used for the teacher interviews include:

1. Is the mandate for all students, in particular SWD, earn a Regents' Diploma a realistic option?

2. How do you accommodate and adapt the algebra curriculum to meet the needs of SWD?

Research Question 4

What is the association between the percentages of (General Education, Special Education) grade eight students who passed the Grade Eight State Mathematics Assessment and the percentages of high school (General Education, Special Education) students who passed the final state algebra examination?

Hypothesis 4

There is no relationship between the percentages of (Special Education, General Education) grade eight students who passed the Grade Eight State Mathematics Assessment and the percentage of high school (Special Education, General Education) students who passed the final state algebra examination.

The dependent variable was the Grade Eight State Mathematics Assessment scores. The independent variables were final state algebra examination scores.

Both the Grade Eight State Mathematics Assessment scores and the final state algebra examination scores were examined to show if performance on the Grade Eight State Mathematics Assessment was an indicator of how a student would perform on the final state algebra examination (SED, 2016c). The scores (i.e., Grade Eight and algebra) from these state assessments were not the same students. The Grade Eight State Mathematics Assessment and final state algebra examination were compared with comparable groups of the students' scores from their cohort year. A cohort is a group of students who work through a curriculum together to achieve the same academic degree together, and specifically, a cohort year is a group of students banded together or treated as one group in an identified grade level (i.e., grade nine, grade eight, and grade seven). The interview question below aligned with Research Question 4 represents the variables used for the teacher interviews include:

1. Do you think the State Mathematics Assessment for grades seven and eight are an indicator of how successful a student will be in taking high school algebra?

Findings

Hypothesis 1

A chi-square test of independence was conducted to examine the relationship between education classification (i.e., General Education and Special Education) and performance (i.e., pass or fail) on the Grades Seven and Eight State Mathematics Assessment from 2006 through 2012. As displayed in Appendix J, chi-square test of independence findings for Hypothesis 1 indicated the relationship between these variables on the Grade Seven State Mathematics Assessment was significant every year. The relationship between student performance for both general education students and SWD on the Grade Eight State Mathematics Assessment was significant every year, with the exception of 2011 (Appendix K). No relationship was found between education classification and performance on the 2011 State Grade Eight Mathematics Assessment when implementing the chi-square test of independence $x^2(1, n = 20) = 3.58, p = .06$. The number of students, the students' demographics, and test format was not different; however, the findings did not show significant finding for 2011 for the Grade Eight Mathematics Assessment. Overall, the findings indicated SWD were less likely to pass

Grades Seven and Eight State Mathematics Assessments compared to general education students.

The findings for Hypothesis 1 (Tables 3.1 and 3.2) represent student performance on the Grades Seven and Eight State Mathematics Assessment from 2006 to 2012 from the chi-square tests. The outcomes are the passing percentage of general education students' performance on the Grades Seven and Eight State Mathematics Assessments was higher each year than the performance for SWD. Most general education learners successfully passed the Grades Seven and Eight State Mathematics Assessments from the years of 2006 to 2012.

Table 3.1

Findings for the Passing Proportion of Grade Seven State Mathematics Assessment for 2006-2012

	2006	2007	2008	2009	2010	2011	2012
Groups	% Pass	% Pass	% Pass	% Pass	% Pass	% Pass	% Pass
General Ed	98	99	99	100	99	99	99
Special Ed	75	84	88	90	86	86	84
Chi-square	20.7	12.6	8.23	8.52	10.4	10.4	12.6
p-value	.00	.00	.00	.00	.00	.00	.00
Significance	S	S	S	S	S	S	S
Total N	644	646	636	648	571	568	605
Total N GE	533	511	510	544	464	470	502
Total N SWD	111	135	126	104	107	98	103

General Ed= students in general education(GE); Special Ed=students with disabilities (SWD).

Table 3.2

Findings for the Passing Proportion of Grade Eight State Mathematics Assessment for 2006-2012

	2006	2007	2008	2009	2010	2011	2012
Groups	% Pass	% Pass	% Pass	% Pass	% Pass	% Pass	% Pass
General Ed	99	99	99	100	99	92	94
Special Ed	78	83	81	92	79	82	81
Chi-square	.65	13.74	16.06	6.38	18.43	3.58	6.58
p-value	.00	.00	.00	.01	.00	.06	.01
Significance	S	S	S	S	S	NS	S
Total N	675	624	614	624	649	562	560
Total N GE	541	519	486	500	542	493	491
Total N SWD	134	105	128	124	107	104	96

General Ed= students in general education (GE); Special Ed=students with disabilities (SWD).

Hypothesis 2

A series of seven chi-square tests of independence were conducted to examine the relationship between education classification (i.e., General Education and Special Education) and performance (i.e., pass or fail) on the final state algebra examination from 2006 through 2012.

The Hypothesis 2 summary (Table 3.3) show the passing percentage of general education students' performance on the final state algebra examination from 2006 to 2012 was greater each year than the performance for SWD.

Table 3.3

Findings for the Passing Proportion of State Regents Algebra Examination for 2006-2012

	2006	2007	2008	2009	2010	2011	2012
Groups	% Pass	% Pass	% Pass	% Pass	% Pass	% Pass	% Pass
General Ed	99	99	99	99	94	98	96
Special Ed	64	69	81	87	89	85	84
Chi-square	38.3	31.3	16.1	7.21	1.03	9.3	6.7
p-value	.00	.00	.00	.01	.31	.00	.01
Significance	S	S	S	S	NS	S	S
Total N	736	783	697	502	522	621	572
Total N GE	568	639	540	435	394	475	432
Total N SWD	168	144	157	82	128	146	140

General Ed= students in general education (GE); Special Ed=students with disabilities (SWD).

Hypothesis 3

Chi-square test of independence was conducted to examine the relationship between education classification (i.e., General Education and Special Education) and performance (i.e., pass or fail) to earn a State Regents Diploma from 2006 through 2012. As displayed in Appendix M, the relationship between these variables was significant every year. Overall, the findings indicated the percent of SWD were less likely to earn a State Regents Diploma.

The Hypothesis 3 summary outcomes (Table 3.4) denote the type of student high school diplomas earned from 2006 to 2012 from the identified school district. The results were the percentage of general education students' graduating with a State Regents Diploma was larger each year than the percentage of SWD graduating with a State Regents Diploma from 2006 to 2012. Fifty-four percent of SWD who graduated between, 2006 to 2012 received a State Local High School Diploma.

Table 3.4

Findings for the Proportion of State Regents High School Diplomas for 2006-2012

	2006	2007	2008	2009	2010	2011	2012
Groups	% Earn	% Earn	% Earn	% Earn	% Earn	% Earn	% Earn
General Ed	94	95	96	99	100	100	100
Special Ed	57	32	55	51	70	66	61
Chi-square	35.03	89.93	43.25	58.91	32.98	38.59	46.00
p-value	.00	.00	.00	.00	.00	.00	.00
Significance	S	S	S	S	S	S	S
Total N Graduated	582	581	580	637	550	577	560
Total N RE	509	522	528	601	518	549	520
Total N GE RE	469	496	480	548	443	495	458
Total N SWD RE	40	26	48	53	75	54	62

RE= Regents Diploma; General Ed = students in general education (GE); Special Ed = students with disabilities (SWD).

Hypothesis 4

An independent samples *t*-test was selected to analyze two groups of data to determine if there was a relationship between the two groups of data. An independent-samples *t*-test was used to compare the means between two unrelated groups on the same continuous, dependent variable. Research question four used an independent samples *t*-test instead of the chi-square test of independence. The reason the independent samples *t*-test was used because it required two variables; one must be categorical and have two levels, and the other must be quantitative and be determined by a mean. The *p*-level was set at .05 to obtain a *p*-value for the analysis of data. For example, the two groups, Grade Eight State Mathematics Assessment, and the final state algebra examination, determined whether there was statistical verification that the associated group means are significantly different.

An independent samples *t*-test examined the relationship between education classification (i.e., General Education and Special Education) and performance (i.e., pass or fail) for grade eight students who passed the Grade Eight State Mathematics Assessment and the percentage of high school (i.e., General Education and Special Education) students who passed the final state algebra examination from 2006 to 2012. The rational for using the *t*-test was to examine if there was a relationship between the passing performance on the Grade Eight State Mathematics Assessment and the final state algebra examination. As displayed in both Appendix N and Appendix O, the relationship between these variables was not significant. Overall, there was no statistically significant difference between the percentages of SWD passing the Grade Eight State Mathematics Assessment compared to the percentage of SWD who pass the final state algebra examination, $t\ (12) =.605$, $p > .001$. There was no statistically significant difference between the percentages of general education students who passed the Grade Eight State Mathematics Assessment compared to the percentage of general education students who passed the final state algebra examination, $t\ (12) = -.206$, $p > .001$.

The Hypothesis 4 summary compared student performance on the Grade Eight State Mathematics Assessment and the final state algebra examination from 2006 to

2012. The outcomes were both general education students' performance and SWD performance on the Grade Eight State Mathematics Assessment demonstrated a relationship to student performance on the final state algebra examination. As a cohort year group, the percentage of students who passed the Grade Eight State Mathematics Assessment was similar to the percentage of students who passed the final state algebra examination. The cohort year groups were not the same students.

Table 3.5 *Independent Samples t-Test for Hypothesis 4-Performance on State Regents Algebra and Grade Eight Mathematics Assessment for General Education Students*

		2006	2007	2008	2009	2010	2011	2012
Examination	Groups	% Pass	% Pass	% Pass	% Pass	% Pass	% Pass	% Pass
Algebra	General Education	99	99	99	99	94	98	96
Grade Eight Math	General Education	99	99	99	100	99	92	94
t-test	-.206							
N (years)	7							
p-level	.18							

Note. Cohorts are not the same students.

Table 3.6

Independent Samples t-Test for Hypothesis 4-Performance on State Regents Algebra and Grade Eight Mathematics Assessment for Students with a Disability

		2006	2007	2008	2009	2010	2011	2012
Examination	Groups	% Pass	% Pass	% Pass	% Pass	% Pass	% Pass	% Pass
Algebra	Special Education	64	69	81	87	89	85	84
Grade Eight Math	Special Education	78	83	81	92	79	82	81
t-test	.605							
N (years)	7							
p-level	.06							

Note. Cohorts are not the same students

Teacher Interviews

Eight questions were developed by the researcher for a protocol to be used in the teacher interviews (Appendix B). Teachers selected for the interview questions provide academic instruction in algebra for SWD. Teachers were selected to be interviewed because they were teaching in the 2-year algebra class as either a mathematics instructor or special education Teacher. The teachers selected for the interviews had to have more than five years teaching experience with students enrolled in the high school algebra course, so they knew the difference between the one-year algebra course and the new 2-year option. Each teacher interview was audio recorded and took place in the teacher's classroom. Questions for each of the three interviews established how and why each of these respondents believed the new graduation requirements influenced SWD. The goal for the interviews was for each person being interviewed to discuss reasons SWD might have struggled in algebra if middle school mathematics grades were a correlation to algebra proficiency, and if elements of the algebra course might negatively hinder SWD performance.

The teachers' rich responses explained the challenges for requiring all student learners to pass high school algebra. Interview responses to each question were organized by the following themes: (a) foundational mathematics skills, (b) Grade Eight State Mathematics Assessment, (c) course and pace, (d) academic intervention support, (e) repeat course, and (f) realistic goal. Each theme provides data supported by teacher responses to interview questions.

Foundational mathematic skills. Foundational mathematic skills that include basic mathematic computations (i.e., knowledge of multiplication facts) are important for students to achievement prior to entering grade nine and enrolling in the algebra mathematics course. Algebra is a division of mathematics in which symbols (i.e., letters, numbers) are combined to represent numbers and quantities in formulas and equations. Algebraic thinking includes identification and analysis of patterns, studying and representing relationships, making generalizations, and analyzing how things change. Interview questions examined the foundational mathematics skills to include the comprehension of pre-algebra concepts from middle school and the ability to proficiently solve basic arithmetic functions prior to enrollment in a high school mathematics course. Quantitative findings present statistically significant findings to show a trend for more SWD from the identified school district who do not pass the Grade Eight State Mathematics Assessment are likely not to pass the final state algebra examination. Each teacher believed that the Grades Seven and Eight State Mathematics Assessments were not a predictor of performance (i.e., pass or fail) for students participating in the algebra course and final state algebra examination. The teachers explained many of the students they have instructed who have passed the Grade Eight State Mathematics Assessments did not all pass the state algebra course and final state algebra examination. One teacher explained:

> Students are entering the algebra class and they do not have the pre-algebra skills from middle school to build [on their] learning in algebra. [The algebra course] instructs topics students need to comprehend to pass the final exam. [Many] students enter algebra without the knowledge and skills of pre-algebra topics [and are] not prepared to learn the content [for the algebra course] (Participant 1, Interview).

Another teacher discussed, “More general education students who passed the Grade Eight [State Mathematics] Assessment do not always successfully pass the final state algebra examination” (Participant 3, Interview).

The teachers shared how the Grade Eight State Mathematics Assessment is not a sequential examination for the algebra course as students do not have to pass a summative examination prior to enrollment in the algebra course. As a result, more students struggle to pass the final state algebra examination and do not earn high scores on the examination. One teacher explained that the final state algebra examination is a hard exam for many students to pass. The examination includes many rigorous algebra concepts that are multiple-step word problems (Participant 1, Interview). One teacher stressed, “[The algebra examination is a] very hard exam. It is testing [the students] on many items within one question” (Participant 1, Interview). Two of the teacher participants explained the grade eight mathematics curriculum needs to include more pre-algebra content to provide students a solid foundation prior to enrolling in algebra. The algebra course curriculum does not provide instructional time in the curriculum map to permit teachers to instruct on pre-algebra concepts (Participant 1, Interview; Participant 2, Interview). A teacher explained, “Most of the identified students did not know basic terms like product, quotient, and sum” (Participant 2, Interview). The teachers shared how many students could not solve basic multiplication facts and operate a calculator. One teacher explained, “Students do not know how to solve for simple exponent questions on a calculator” (Participant 3, Interview). Another teacher explained:

> I had to point out the exponent button on the [graphing] calculator and model how to find the answer using the calculator. Students are using the graphing calculator to solve simple mathematic computations like five multiplied by three instead of knowing the answer by memory (Participant 2, Interview).

The teacher participants expressed difficulty in accommodating and adapting curriculum to meet the needs for those SWD because of the large amount of curriculum (i.e., including the state learning standards for algebra) needed to be instructed to prepare students for the final state algebra examination. One teacher revealed, “The increase in many students with [a classification of] special education with three or more years below grade level for mathematics makes it a difficult challenge to teach rigorous concepts to the students who do not have foundational [mathematic] skills (Participant 1, Interview).

Grade Eight State Mathematics Examination. Student performance on the Grade Eight State Mathematics Examination may foretell student proficiency on the final state algebra examination. Teacher participants were asked about the importance of the student performance on Grade Eight State Mathematics Examination as a way to predict performance on the final state algebra examination. The teachers interviewed shared failing scores on the Grade Eight State Mathematics Assessment should be examined to identify students who might need extra support for algebra. The teachers discussed the Grade Eight State Assessment should be used to place students in a 2-year algebra track, not necessarily as an instrument for predicting passing the algebra exam. Students who failed the Grade Eight State Mathematics Examination were at risk for failure of the final state algebra examination. One teacher stressed, "Placement in a Resource Room prior to the start of the school year will provide the opportunity to remediate and reteach concepts in algebra class" (Participant 3, Interview). A second teacher shared, "Providing additional time outside of the classroom is critical for students who are struggling to comprehend the algebra [curriculum]" (Participant 1, Interview).

Each teacher stated the importance of providing instructional support to students who failed the Grade Eight State Mathematics Assessment. A teacher shared, "When these students took algebra, they needed an opportunity to get the extra help to understand the [algebra] content needed to succeed in pass[ing] the [algebra] course" (Participant 2, Interview).

In summary, the teachers stated the importance of providing instructional support to students who failed the Grade Eight State Mathematics Assessment. Providing school interventions to help students review and practice algebra content is important. Students need the instructional interventional support at school to get help with the rigorous algebra curriculum. The Conceptual Framework (Figure 2.1) illustrates the importance of instructional approaches to improve the algebra achievement for SWD to earn a high school diploma.

Algebra course and pace. The algebra course has a rigorous curriculum to include required state learning standards needed to be instructed during the course. The course has one academic year to instruct all required algebra concepts which are tested on the final state algebra examination. Teachers articulated in their response to the interview question, elements about the 1-year algebra course curriculum map (Figure 3.5) commonly provided difficulty to the SWD. One teacher explained, “[Most SWD are] not familiar with the pace of completing a lesson per class period and a test every two-weeks” (Participant 1, Interview). Another teacher shared, “Students would forget [the algebra] content that was instructed the day before and needed the teachers to reteach the lesson from yesterday again” (Participant 2, Interview). One of the teacher participants expressed: “During the Resource Room period, the students would need [algebra] concepts retaught from previous [algebra] chapters. The [algebra course] pace moves too fast. The students are having trouble mastering and remembering what the [algebra] course has instructed” (Participant 3, Interview).

In summary, the three teachers expressed that the rigor of the algebra concepts and the pace of the lessons and topics made the algebra course challenging for all students. The teachers indicated SWD struggled to meet the required proficiency of the algebra course and final state algebra examination.

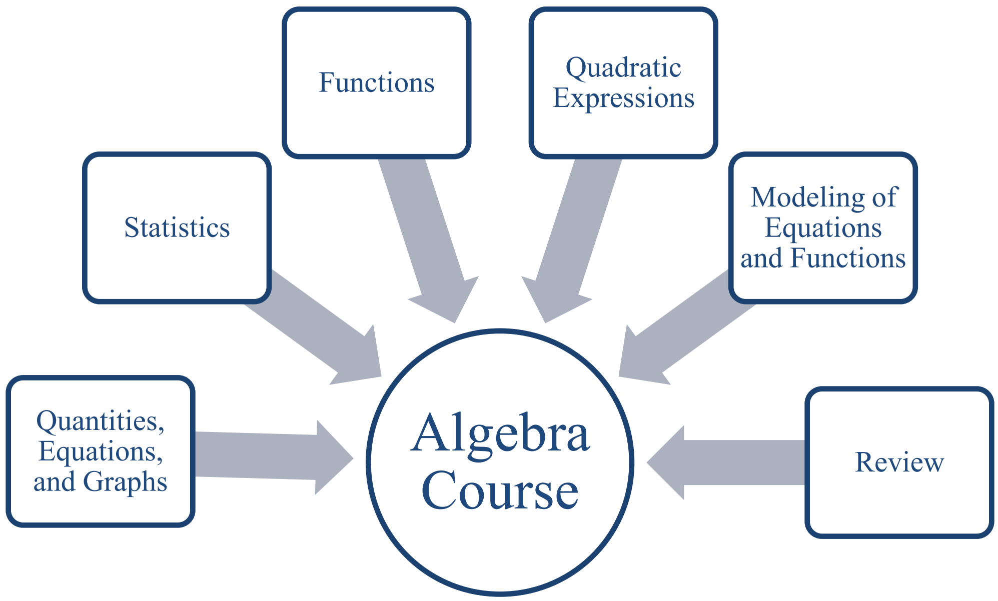

Figure 3.5. Curriculum topics for the algebra course.

Academic intervention support. Teachers voiced that instructional support systems outside of the algebra course were beneficial to help SWD meet proficiency in algebra. School support systems included the learning center (i.e., a school center open to all student to receive academic support for all classes), a class period of Resource Room (i.e., formal special education placement for SWD to get additional instructional support), and after-school mathematics assistance (i.e., each algebra course instructor provides 45 minutes of algebra help after school each day for students). The teachers during the interview agree with the benefits of providing academic instructional support to help students comprehend the algebra concepts. One teacher stated, "[That all SWD who] failed grade eight math, need[ed] the daily placement of Resource Room to provide the necessary academic support for the student" (Participant 3, Interview). A second teacher shared: "[Students who] participated in after-school help left school for the day understanding the [algebra] lessons. Students like the opportunity to get individual help on homework and classwork. Students feel more confident about algebra" (Participant 2, Interview).

In conclusion, providing the additional instructional support opportunities for students to get help for understanding the curriculum content in the algebra course was beneficial. The teacher participants expressed how the additional instructional support opportunities have positively impacted student understanding and performance in the algebra course.

Repeat course. The teachers were inquired if having students who failed the algebra course were more successful passing the final state algebra examination when they repeat the course. Overall, each teacher strongly believed that SWD who failed the algebra course and examination were often not successful at a second attempt after repeating the course. All three teachers expressed the need to implement instructional support within the school day to help struggling students to prevent them from failing. During the teacher interviews, each teacher shared student examples of students who attempted algebra again in summer school or the next year and had trouble achieving proficiency. A teacher participant discussed:

> [A female student who] did not pass the algebra course, needed to retake the algebra course again in the summer. [This student] passed the algebra course in summer school, [but] failed the final state algebra examination. [She] did not pass the final state algebra examination after three attempts. [This student did] pass the less rigorous State Regents Competency Examination in Mathematics and graduated from high school with State Local Diploma instead of a State Regents High School Diploma (Participant 3, Interview)

Two of the three teachers discussed specific students who dropped out of high school because of the unsuccessful second attempt for taking the state algebra course. The teacher participant explained:

> [The identified student] failed the algebra course three times [and] he gave up. [The student also] was not passing [required courses of] Global History I and Earth Science. [As a result,] he felt school was not for him, and he left [high] school (Participant 1, Interview). (Participant 1, Interview).

Another participant also shared:

> One student who dropped out of high school to pursue their GED (General Education Development). [The student] felt the difficulty and challenges [of the algebra course] content was not something he could reach (Participant 1, Interview).

In summary, the teachers expressed the students who initially failed the algebra course had difficulty passing the course and final state algebra examination a second time when retaken during summer school and the next school year. The teachers shared the importance of providing support to help students pass algebra when enrolled in the course for the first time.

Realistic goal. An interview question addressed teachers' perceptions about the change in policy for all student learners to earn an algebra credit (i.e., passing both the final state algebra examination and the algebra course) to graduate from high school and if they believed it was a realistic goal. The teachers believed the mandate for all students in the state, in particular, those SWD to earn a Regents' Diploma, was not a realistic option in the absence of additional resources to provide students with more intense academic supports.

The one teacher participant stated, “Students have different strengths. It was unfair to create a solitary track for all students to follow” (Participant 3, Interview).

A teacher participant articulated:

> Each student learns differently. Each student many need more time to grasp a[n] [algebra] concept. We should not make all the [high school] students be required to complete the same tasks at the same time. Responsible learning and instruction in [high] school should be provided to support a variety of learners (Participant 1, Interview).

Another teacher added, “Failing performance in one class should not prevent an individual from receiving a high school diploma” (Participant 2, Interview). The teacher shared her feelings about the requirement for students to pass both the algebra course and final state algebra examination was not fair for some students (i.e., varying degrees of learning disabilities). Students should have the choice to take and pass another course like an alternative mathematics course to allow students to graduate from high school.

In summary, the responses from each of the three teacher interviews provided insight into how the new graduation requirement and the rigorous algebra course influenced SWD. For each of the eight questions, the teachers all shared similar responses, perspectives pertaining to the requirement of mathematics, and viewpoints about SWD required to pass algebra. The interview responses revealed the understanding and opinions of teachers who were influenced by the revised state high school graduation requirements.

Summary

Through the data collected from interviews, all three teachers believed the Grade Eight State Mathematics Assessment did not represent an indicator of student success on the final state algebra examination. However, as referenced in Tables 3.1, 3.2, and 3.3, statistically significant data suggest that students who passed the Grade Seven and Grade Eight State Mathematics Assessments were likely to pass the final state algebra examination. For general education students from 2006 to 2012, 97% passed the Grade Eight State Mathematics Assessment and 98% passed the final state algebra examination (Appendix N). SWD from 2006 to 2012 (Appendix O) had an average passing percentage on the Grade Eight State Mathematics Assessment of 82 and the passing percentage for the final state algebra examination was 80. Twenty percent of SWD did not pass both the Grade Eight State Mathematics Assessment and the final state algebra examination, compared to an average of 2% for general education students' performance on these assessments. The findings demonstrate students who did not pass the Grade Eight State Mathematics Assessment, do not pass the final state algebra examination. Teacher responses from the interview questions expressed the passing rate for SWD needs to be improved, the design of the algebra course, along with other key instructional interventions need to be implemented to increase student achievement on the final state algebra assessment.

The findings from the statistical data demonstrated significant findings to support Research Questions One and Two, SWD who participated on the Grades Seven and Eight State Mathematics Assessments were less likely to achieve a passing score. The findings for Research Question Three supported significant findings to show that SWD are less likely to pass the final state algebra examination and receive a Regents High School Diploma. The findings for Research Question Four demonstrated there is no statistically significant difference between the percentage of SWD who pass the Grade Eight Math Assessment compared to the percentage of SWD who pass the final state algebra examination (t (12) =.605, p>001). There is no statistically significant difference between the percentage of general education students who pass the Grade Eight Math Assessment compared to the percentage of general education students who pass the final state algebra examination (t (12) = -.206, p>;.001). The percentages of cohorts for both general education students and SWD who passed the Grade Eight State Mathematics Assessment were similar to the percentages of both cohorts for general education students and SWD who passed the final state algebra examination (Tables 3.5 and 3.6).

In summary, the study illustrates the barrier for SWD created by the algebra requirement (Teitelbaum, 2003). In conclusion, the identified school district has seven years of testing data (i.e., 2006 to 2012) to demonstrate the needs to make changes to the current algebra course curriculum and learning environment to help improve the passing rate for SWD on the final state algebra examination.

Chapter 4. Intervention Literature Review

Since the implemented change to the state high school graduation requirements, fewer SWD have met the state algebra requirement and instructional options to improve student performance needed to be considered for incorporation into the high school algebra course (Steele, 2010). Previously, students could earn a less rigorous diploma (i.e., Local Diploma). The formally offered State Local Diploma did not require students to take an algebra course or pass the final state algebra examination. Findings from the needs assessment showed from 2006 to 2012 44% of SWD in the identified school district graduated with a State Local Diploma, and 56% of SWD graduated with a State Regents Diploma (Appendix I).

The purpose of this chapter is to provide an overview of the rationale to support the creation of the 2-year algebra course in response to the new algebra graduation requirement had on SWD. The study examined whether the implementation of a 2-year algebra course option, content from a traditionally 1-year algebra course spread over two years, would increase proficiency rates on the final state algebra examination for SWD. Currently, the school system offers a 1-year algebra course. The proposed 2-year algebra course would allow additional instructional time to teach proven instructional strategies including evidence-based practices to ensure mastery of fundamental algebra concepts.

Course Elements

Over the past decade, the leadership of high schools has worked to improve learning outcomes for all students (Dettelis, 2010). Educators within individual school districts examined what practices were implemented to help all students graduate from high school (Cala, 2003; House, 2007). Some of the approaches were to examine what methods teachers used in required courses and the instructional supports necessary to support positive outcomes for students.

The proposed option is a 2-year algebra course designed to improve student achievement in high school algebra. Course design for the 2-year algebra course intervention includes the use of instructional strategies including evidence-based instructional supports were essential to student learning and considerations in the development and delivery of the 2-year course. A key design component for the 2-year algebra course includes two teachers, the general education mathematics teacher and the special education teacher. Together the co-teachers can provide instructional practices (i.e., testing accommodations, evidence-based practices) to improve students' learning for the algebra course content. The implementation of the 2-year algebra course design included (a) smaller class size, (b) slower instructional pace, and (c) additional training for both general and special education teachers delivering the longer course format. The course design elements for the 2-year algebra course include the creation of smaller size classes (i.e., number of students enrolled per each course section) and slowing the instructional pace (i.e., more time to teach algebra concepts) are important to support student achievement in algebra.

Small Class Size

One key component for the 2-year algebra course was smaller class sizes which includes, the number of students in a given course, including (a) the number of students being taught by individual teachers in a classroom and (b) the mean number of students being taught by teachers in a school (The Glossary of Education Reform, 2015). The implementation of standardized courses, particularly algebra had increased student enrollment in those courses in response to the requirement for all student learners to earn an algebra credit (i.e., passing both the course and final algebra state examination) to graduate from high school.

One study examined the achievement of 300 students from grades nine to eleven at two high schools from the Bronx in New York State that included small class enrollment sizes to improve student achievement to successfully pass courses required for high school graduation (House, 2007). Many states require algebra to be taken in high school, but algebra proficiency is not a high school graduation requirement for SWD (House, 2007). In the study, two highs schools implemented the Institute for Student Achievement (ISA) Strategy to model a framework to help students succeed. ISA is a national high school redesign organization whose mission is to work with high schools to provide students with a rigorous and supportive learning environment. In both schools, the instruction was challenging, and there was one course of study-college track. This research includes interviews with: Students, principals, and teachers to explain why their school was succeeding in helping students navigate the algebra requirement and graduate from high school. One key element discussed in the study for the ISA Strategy was the implementation of a smaller number of students enrolled in required rigorous courses. Data for the study examined the course grades and graduation of students from high school within four years. House (2007) found smaller classes were more beneficial for both challenging and required courses such as the algebra course to graduate with a high school diploma. Courses with enrollment between 12 to 15 students provided the teachers and students with more opportunities to communicate and offer opportunities within the course for individualized instructional support to improve students' understanding of algebraic course curriculum content (House, 2007).

Smaller class sized academic courses facilitate the key components promoted by the social cognitive learning theory and the two-store cognitive model (Bruning et al., 2011; Schunk, 2008). Students need to recall prior knowledge to continue to build on concepts throughout the algebra course. Providing a smaller class enrollment size might provide more opportunities for teachers to monitor each student's comprehension of algebra concepts (Ellerbrock & Kiefer, 2013; House, 2007). Ellerbrock and Kiefer (2013) examined information of two similar large high schools with similar socio-economic and ethnic diversities and ways in which classroom sizes and the school environment may impact student academic performance. They conducted a qualitative, multi-case study to analyze how students' needs were provided in a variety of different enrolled classes in the school setting (Ellerbrock and Kiefer, 2013). Examination of data to determine if students' needs were met in the smaller enrollment sized classrooms included interviews and observations of 23 participants. The participants consisted of four middle school students, 13 high school teachers, four middle school teachers, a middle school principal, and a high school principal. Administration and teacher participants from the case study shared the importance of creating a small, structured learning environment to allow and encourage teachers to have a connectedness with their students (Ellerbrock & Kiefer, 2013). The study supported the implementation of smaller enrollment of classes, and the creation of smaller class sections of the algebra course allowed students to get the instructional attention needed to comprehend and meet proficiency. Examined data represented students' scores on assessments and classes taken in high school and middle school. A reduction in class enrollment increased more student and teacher interactions in algebra. Smaller class sizes allowed course teachers to better assess student understanding of key concepts (Ellerbrock & Kiefer, 2013; House, 2007).

Another study noted that smaller class size contributed to student success (Feigenbaum & Friend, 1992). The study included 40 college students; 20 first-year students and 20 upper-level students enrolled in psychology courses complete a questionnaire about the structure of psychology courses. An analysis of variance was conducted, and findings support the correlation for freshmen students preferring a small class size setting (Feigenbaum & Friend, 1992). Students reported when they are enrolled in a course with less than 15 students; they are more likely to actively participate in the class by asking questions from other students and the teacher (Feigenbaum & Friend, 1992). Smaller classes allowed the teacher the opportunity to become more familiar with students and understand potential academic concerns (Ellerbrock & Kiefer, 2013; Feigenbaum & Friend, 1992; Roybal, Thornton, & Usinger, 2014).

In summary, smaller course sizes can positively impact the student learning and academic achievement required for both state and federal education policies. The justification was if teachers have fewer students, they can devote more time and attention to students in their class to include more time critiquing work products and providing students one-on-one instruction and academic support (The Glossary of Education Reform, 2015). Small enrollment per each class of the 2-year algebra course would provide opportunities for students to receive more individualized teacher support. In conclusion, small size classes of 15 students or less allowed students to receive the necessary individualized instructional support from the co-teachers to successfully learn the required content (Feigenbaum & Friend, 1992).

Instructional Pace

The instructional pace is the speed with which a teacher instructs academic content during the time allotted. Teachers interviewed in the needs assessment expressed that multiple algebraic concepts covered in the algebra course in the 1-year course option required a rapid pace of instruction. They reported the rapid pace and rigor of the algebra curriculum contributed to SWD inability to meet proficiency in algebra. One study examined SWD’s placement and performance in algebra as either an eighth grader or ninth grader (Faulkner, Crossland, & Stiff, 2013). The study examined student mathematics test performance in grade seven to determine readiness for students entering grade eight to enroll in the algebra course in eighth grade, instead of the ninth grade. The study relates to the pace of instruction for the algebra course and how it impacted the SWD enrolled in the algebra course. The pace of learning in a rigorous mathematics course was a challenge for many SWD. The students were unsuccessful in comprehending and applying algebraic concepts to achieve proficiency. Three thousand fifty-five, grade eight students were examined, which included 281 SWD. Sources of evidence the study used included the Early Childhood Longitudinal Study-Kindergarten (National Center for Educational Statistics, 2002) to gather information about students, the types of courses taken, and the students’ disability. Moreover, the researchers found that SWD were not frequently selected for enrollment in the algebra course in eighth grade because they had failing scores on the seventh grade, state mathematics assessment. SWD have demonstrated a long history of needing additional support for performance in mathematics, and their disability may "demonstrate difficulties with mathematics" (Faulkner et al., 2013, p. 331).

More instructional time and a slower pace of instruction provided within a course is an essential component to support student learners to comprehend course content. Jez and Wassmer (2015) studied 310 elementary schools and 5,087 elementary students in California for the duration of one school year. In this study, students received 15 minutes more of instructional time per course to improve their outcomes on standardized assessments. The two findings from the study support a statistically significant relationship between the findings of student performance on standardized tests, Academic Performance Index (API), and the number of instructional minutes in one academic school year. The findings were a gain of 1.5% for overall student academic performance on state standardized tests. In conclusion, the implementation of a course option with a small class enrollment size supported co-teachers (i.e., algebra and special education teachers) accommodating and allowing more class time to instruct algebraic concepts.

Lastly, increasing the pace and amount of instructional time can be an "effective means to support student learning, particularly for students who are most at risk of school failure" (Patall, Cooper, & Allen, 2010, p. 431). Patall et al. (2010) examined 15 empirical studies from 1985 to 2009 to investigate how the advantages of additional instructional time can impact student learning. Students at risk of not meeting academic proficiency, benefit from more opportunities for instructional time in school. The systematic review of studies pertaining to the addition of time during the school day revealed additional instruction may be useful for individuals to learn challenging academic concepts including the content area of mathematics across all grade levels (Patall et al., 2010).

Instructional Practices

General education teachers are often challenged to implement effective teaching practices for the various student learners enrolled in a large class of mixed academic ability students with a high percentage of SWD (Foegen, 2008; Hunt & Little, 2014; Swanson, Solis, Ciullo, & McKenna, 2012; Van Garderen, Scheuermann, Jackson, & Hampton, 2009). Foegen (2008) examined using instructional tools within a course to help students master the algebra concepts. Instructional strategies are practices teachers can implement to improve a student's focus of attention to organizing classroom learning to retain and retrieve academic course content successfully. Project Algebra Assessment and Instruction: Meeting Standards (AAIMS) was pioneered to help high school SWD excel in mathematics and to provide a format or plan for secondary special education teachers to help their students learn and successfully apply the content in the mathematics classes. The sources of evidence were examining three high schools in Iowa who participated in this study and incorporated the AAIMS in algebra class. Data from the standardized Iowa Tests of Educational Development (ITED) that the schools administer annually were used to examine the success of using the AAIMS Program for algebra. Teacher responses from interviews indicated an increased need for professional development on learning effective strategies specific to algebra. One particular area of professional development that both teachers of general education and special education advocated for were training opportunities in evidence-based practices. Creating opportunities for staff development for general education teachers to learn strategies (i.e., graphic organizers, peer tutoring) was suggested by the study to improve algebra proficiency including training sessions throughout the school year to provide guidance, and support to both general education algebra teachers and special education teachers on how to implement ways to teach algebraic concepts successfully (Foegen, 2008).

Instructional strategies are practices and techniques used within an academic course to support independent student learning (Foegen, 2008; Van Garderen et al., 2009). The focus of an article by Van Garderen et al. (2009) was an overview of mathematics instructional strategies from research studies for general and special education teachers who teach mathematics. The total number of participants in the article were 1,550 SWD and 1,730 general mathematics students. The sources of evidence in this study are 50 recently published studies that include proven methods to help all student learners (i.e., general education and special education) improve their mathematics proficiency. A concise guide of strategies for teachers to use as a resource to instruct mathematics to SWD and general education students were included in the article. In addition, the article advocated in-service training opportunities for mathematics teachers to learn the instructional strategies proven to help many students at various levels of competence in mathematics (Van Garderen et al., 2008).

Implementation of instructional effective mathematics strategies in the classroom can support student achievement to comprehend, store, and apply academic content successfully. The study provides instructional interventional suggestions for teachers to use in the classroom. A study of instructional practices used by special education teachers of students in grades three through five by special education teachers examined their opinions of Response to Intervention (RTI) while delivering mathematics instruction

(Swanson, Solis, Ciullo, & McKenna, 2012). The collected data used for the study were from a large school district over a five-year span. Methods used to obtain information were through classroom observations with both general and special education teachers instructing only SWD. Interviews with 25 special education and general education teachers help to understand their perspective of implementing RTI framework in a mathematics class. Observations and comments made by both the special education and general education teachers in the study allow one to conceptualize how different learning strategies and collaborative teaching techniques can help improve the learning environment in a mathematics class. The outcomes from the study discuss the importance for teachers to support professional learning opportunities to learn various learning strategies that improve student performance in mathematics (Swanson et al., 2012).

The NCTM *Principles and Standards* document promotes students to be proficient in problem-solving skills, higher levels of mathematics, and recommends mathematics teachers to include proven instructional strategies to effectively teach mathematics (National Council of Teachers of Mathematics, 2016). This task can be challenging for students who have a history of mathematics failures on state assessments and course grades. To support student achievement in mathematics, teachers need to introduce and promote the techniques of successful instructional strategies in the classroom (Gagnon & Maccini, 2007). Gagnon and Maccini (2007) focused their study on the competencies of general and special education teachers who teach mathematics. Sources of evidence used to examine how teachers perceive their talent and ability to help students with special education services successfully pass mathematics was through a random sample of mailed surveys. More than 167 secondary public school teachers throughout the United States responded to the survey. The mailed surveys examined teachers' perceptions regarding content knowledge with course topics, and the use of instructional strategies. The data analysis included independent samples *t*-tests and chi-square tests to categorize further and analyze the returned surveys. The findings of the study support: special education teachers need to know and implement the NCTM standards for high school mathematics courses (i.e., pre-algebra, algebra, geometry, trigonometry, and statistics), and special education teachers need additional professional learning opportunities at teaching higher levels of mathematics. The findings of this study were to provide professional development learning opportunities to both general and special education teachers to improve instructional approaches for high school mathematics courses (Gagnon & Maccini, 2007). The outcomes address the gaps in special and general education teachers' abilities to guide SWD to success in mathematics.

Student Learning in Algebra

The instruction of SWD in self-contained classrooms by special education teachers for required academic courses for high school graduation were replaced with co-teaching courses in the many schools across the United States (No Child Left Behind, 2001; IDEA, 1997). Students have to be educated by teachers certified as a highly-qualified teacher in the discipline they teach (Allensworth et al., 2009; DeBray, 2005). Additionally, changes to graduation requirements necessitated the school systems to adopt evidence-based practices to support a more rigorous curriculum.

The cognitive theory supports providing different classroom structures to improve student comprehension and to develop cognitive skills. Cognitive learning theory stresses the "need for repetition and practice in helping our students increase their cognitive capabilities" (Bruning et al., 2011, p. 7). The instructional supports for students with special needs in the algebra course included (a) testing accommodations, (b) placement in a Resource Room, (c) extended use of manipulatives, and (d) use of graphic organizers to solve multiple-step word problems.

Methods of Student Support

The Resource Room is a setting where SWD receive direct, academic instructional interventions, and assistance with classwork in a separate classroom located within the school as described in Part B of IDEA (IDEA, 1997, 2004). The Resource Room is an inclusive intervention placement for one class period outside of the general education setting for SWD. The purpose of the Resource Room is to provide additional instructional support (i.e., reinstruct course curriculum, homework, and projects), testing accommodations, and to implement achievement testing. The capped class size for enrollment in a Resource Room placement was at five students for one academic class period. The cognitive learning theory stressed the need to provide opportunities for repetition and practice to help students increase their achievement in school (Bruning et al., 2011). The Resource Room placement provides opportunities for students to receive instructional intervention support during the school day. Many SWD will have their test from other academic courses administered in the Resource Room to be sure all test accommodations are implemented (i.e., extended time, separate location, and tests read). Packard, Hazelkorn, Harris, and McLeod (2011) examined SWD receiving instruction in the general education setting to explore ways in which the addition of a small group setting improved students' performance. The purpose of the study was investigating the effectiveness of 14 ninth grade SWD receiving services in the Resource Room compared to SWD in a co-instructional setting in a general education classroom. A pre-test and post-test design were implemented over a 12-week span using a measure of an end of the course summative assessment. The authors' findings supported the benefits of providing strategies to help students learn academic concepts in a small group environment (Packard et al., 2011). Outcomes from the study were SWD who received support services in a Resource Room achieved higher scores on the end of the year assessment than SWD who were receiving instruction a co-instructional setting (Packard et al., 2011). The implications for the study indicate SWD with Resource Room placement during the school day had higher final examination scores than SWD in a co-taught classroom without a Resource Room placement. Findings for the study support SWD to include a placement of Resource Room to provide interventional instruction.

Schools providing time (i.e., class period) within the school schedule for SWD to receive additional instruction was supported in a study by Jones and Hensley (2012). The researchers interviewed 51 SWD enrolled in a high school algebra course using the Arc's Self-Determination Scale (1995). Additionally, 12 special education teachers completed a 28-item questionnaire about their level of support for the students. Constructs the questionnaire examined were the areas of dependency, conflict, and the close relationship with students gained through the placement setting to include students getting extended practice, re-teaching opportunities, and testing accommodations. Findings from the study support SWD enrolled in a Resource Room placement had greater feelings of self-determination than SWD in a self-contained classroom placement (Jones & Hensley, 2012).

In summary, opportunities for instructional intervention support during the school day were important for some student learners to properly master key concepts of the algebra course (Jez & Wassmer, 2015; Jones & Hensley, 2012; Patall et al., 2010). Providing additional instructional time for instructional interventions was found to improve proficiency in algebra (Maccini & Gagnon, 2006). Instructional intervention support services can provide students with the opportunity to receive the academic support individually to achieve proficiency in their general education classes. In summary, the Resource Room setting offers both individual and small group instruction to reinforce instruction in core instruction, support with academic assignments, and have mandated IEP testing accommodations implemented (Jones & Hensley, 2012).

Multiple Representations

The use of multiple representations (e.g., mathematics blocks, mnemonics, visual representations) provides a way for students to comprehend mathematical concepts through appropriate practical experience and concrete, hands-on-learning. A manipulative is a physical object used to represent algebraic concepts. Mulcahy et al. (2014) studied the importance of providing a variety of accommodations to support the secondary mathematics instruction to include the High School Mathematics Common Core State Standards. The article examined 20 peer-reviewed studies on a variety of promising intervention strategies to help high school SWD meet proficiency in mathematics. Most of the promising practice interventions included the use of manipulatives to provide students a hands-on-experience to solve algebra computations. Interventions such as Cover, Copy and Compare proved promising for secondary mathematics largely focused on solving word problems and included a strategy to improve academic performance and conceptual understanding. For example, Cover, Copy, and Compare is an evidence-based strategy to support fluency for mathematics computations (Mulcahy et al., 2014). In this strategy, a student first examines a solved mathematics problem. Second, the student will cover the mathematics problem, copy the mathematics problem, and then solve the mathematics problem independently. Third, the student will compare their solution to the original mathematics problem solution to check for accuracy. The interventions used in the mathematics class included the use of hands-on manipulatives for students to make concrete solutions from algebra problems (Mulcahy et al., 2014). The findings from the study reinforce the importance of using concrete instructional strategies to help students understand abstract applications and concepts. Using effective, proven, concrete, mathematics instructional strategies help students learn the algebraic content, store the knowledge and skills successfully, and later retrieve the learning to apply when solving algebraic computations. The goal of the study was to provide a set of promising practices to support learning in secondary mathematics courses (Mulcahy et al., 2014).

Using teaching strategies that are proven to improve student understanding of algebra concepts is necessary for students to be proficient in algebra. The study evaluated the impact of teaching strategies for solving mathematics word problems for SWD using manipulatives such as counting blocks (Maccini et al., 1999). Using manipulatives (i.e., blocks) was the initial step for improvement. One hundred fifty-eight students from a high school algebra course participated in the six studies, and the students who participated in the study had to use their cognitive skills to solve algebra problems aloud. Findings of the study showed students gained improvement in algebra word problems when they were provided detailed instruction on key terms and using manipulatives

(Maccini et al., 1999). Students in the study used different-sized, colored, plastic, blocks to support the solving algebraic problems, specifically in the topic areas of integers, expressions, and equations (Maccini et al., 1999; Maccini & Ruhl, 2000). In summary, the findings for the study support providing hands-on manipulatives (i.e., blocks) to effectively help students solve mathematic calculations as also represented by the instructional setting factors included in the conceptual framework (Figure 2.1) for impacting the algebra achievement for SWD.

Visual models are trial representations of objects to aid in the comprehension and application of mathematical concepts (Artus & Dyrek, 1989; Witzel, 2005). Incorporating visual representations such as number lines, number paths, graphs, strip diagrams, drawings, and other forms of pictorial representations including real-world situations help students understand abstract mathematical computations. Middle and high school mathematics courses incorporate visual representations to help improve student's understanding of abstract mathematics' concepts (Witzel, Mercer, & Miller, 2003). Visual representation of diagrams and pictures used to teach fractions also help students make sense of the necessary steps for solving multiple-step word problems (Artus & Dyrek, 1989; Fuchs, Powell et al., Witzel, 2005). For example, strip diagrams (i.e., illustrations of small rectangles to show quantity connections) are one type of diagram that can be used. The strip diagrams allow students to logically understand and solve algebraic computations (Gersten, Beckmann, Clarke, Foegen, Marsh, Star & Witzel, 2009). The research studies' findings support the use of both concrete and visual models in mathematics courses resulted in improved mathematical achievement and comprehension for students (Artus & Dyrek, 1989; Butler et al., 2003; Fuchs, Powell et al., 2008; Fuchs et al., 2005; Witzel, 2005; Witzel, Mercer, & Miller, 2003). In summary, using visual models to reinforce the learning and comprehension of mathematics concepts at the concrete level support the strengthening for understanding abstract mathematical computations (Gersten et al., 2009).

A mathematical manipulative is a physical object used to help a student understand a mathematical concept. There are two forms of mathematical manipulatives: concrete and virtual. Virtual manipulatives are commonly related to computer technology to include software and the Internet. One study examined three male secondary mathematics, SWD to examine the impact of using virtual manipulatives as an effective tool to improve comprehension (Satsangi & Bouck, 2015). Students in the study accessed virtual manipulatives from the National Library of Virtual Manipulatives online program. The three students used the Algebra: Grade 9-12 section of the website to successfully comprehend and solve algebra problems. The teacher in the study modeled how to use the National Library of Virtual Manipulatives online program to solve algebra problems for area and perimeter. The students were given opportunities in class to use the website to solve for area and perimeter word problems accurately. On the website, students were encouraged to take the abstract area and perimeter word problems and design a concrete model to solve the algebra word problems accurately. After a two-week hiatus from initially learning how to access and implement the virtual tools, the students in the study correctly solved area and perimeter problems with success using the virtual tools (Satsangi & Bouck, 2015). The outcomes from the study support the utilization of virtual manipulatives to instruct SWD when solving abstract algebraic word problems accurately (Satsangi & Bouck, 2015).

Use of mathematical manipulatives includes mathematical virtual learning tools for students to use web-based applications to reinforce the learning and retention of mathematical concepts. Technological support programs include applications for the iPad (i.e., Ruler, Geography Pad, Number Pieces), and websites (i.e., Kahn Academy, YouTube Videos, Paul's Online Math Notes) to provide the opportunity for students to review the mathematics lesson content and to get help to successfully complete mathematical computations (Moyer, Bolyard, & Spikell, 2002; Satsangi & Bouck, 2015; Suh & Moyer, 2007). Teachers include on their course web pages links to YouTube videos created by themselves or other mathematics teachers to provide an opportunity for students to review the instruction of mathematical concepts. The availability of the links allows students to review and reteach themselves content instructed in the mathematics course. Applications provide manipulatives for students to solve mathematic computations successfully. These applications include a graphing calculator, a protractor, mathematics blocks, algebra pattern blocks, and graph paper to assist in answering mathematical equations. Websites for mathematical manipulatives provided the opportunity for students to review and retain knowledge of mathematical concepts (Moyer, Bolyard, & Spikell, 2002; Satsangi & Bouck, 2015; Suh & Moyer, 2007).

In conclusion, providing multiple representations (i.e., visual models, concrete manipulatives, and virtual manipulatives) can support the students' performance in high school mathematics for solving and understanding word problems. An area directly impacting students' performance in high school mathematics was solving and understanding multiple-step word problems (Maccini et al., 1999). In the Conceptual Framework (Figure 2.1), the instructional setting was a major factor impacting student learning in the algebra course. The instructional setting includes approaches used by the course teachers to improve student comprehension and achievement of algebraic concepts.

Graphic Organizers

Another method to support students solving word problems included using graphic organizers. Graphic organizers provide an evidence-based practice to support successful learning for SWD (Maccini & Ruhl, 2000; Witzel, Mercer, & Miller, 2003). A graphic organizer is a tool to support the students' ability to visualize and make abstract ideas concrete through a diagram to understand a particular concept, situation, or academic question (Ives, 2007; Maccini & Ruhl, 2000).

Graphic organizers help all student learners, including SWD, organize and make clear their thoughts to successfully find solutions to improve proficiency in solving multiple-step word problems. An overview of research supporting the benefits of graphic organizer studies (Table 4.1) and the indicators of quality (Table 4.2) are provided. Each of the selected studies used graphic organizers to help all students, including those SWD who have academic IEP goals to improve proficiency for solving multiple-step word problems. Maccini and Ruhl (2000) examined the mnemonic-based search, transfer, answer, and review (STAR) Strategy. The STAR Strategy was used for students as an organizer to arrange and clarify to solve a multiple-step algebraic word problem. The participants were three secondary students in algebra with a disability. Students in a small group outside of the mathematics course answered each step for an algebraic word problem and showed computations using the STAR Strategy on a worksheet representing each stage. This combination of a mnemonic and graphic organizer supported student success in solving word problems. Student A increased 46 percentage points, student B increased by 26 percentage points, and student C increased by 13 percentage points. Findings indicated increased success solving word problems using the STAR Strategy with “a structured worksheet helped organize students' thoughts while problem-solving” (Maccini & Ruhl, 2000, p.484). The STAR Strategy used as both a mnemonic and a visual graphic organizer in mathematics courses can support student learners to examine each task within a given mathematics word problem to solve accurately.

Using the visual display of a graphic organizer to represent the connections between facts, terms, and ideas within a specific academic subject area is beneficial when solving extended response questions. Zollman (2012) examined the use of graphic organizers in middle school mathematics and the impact on student performance for extended response questions. Nine teachers and 186 students participated in the study. Teachers were instructed to use the four corners and a diamond graphic organizer (Appendix R) weekly with the students from grades six, seven, and eight. Findings of the *z*-scores and Cohen’s *d* showed strong benefits for using the four corners and a diamond graphic organizer. Zollman (2012) used pretests and posttests to measure the beneficial use of graphic organizers. The findings promote the use of a graphic organizer to support student achievement in mathematics for solving word problems.

Research shows there is a positive impact on student learning using the graphic organizer for increasing student achievement (Ives, 2007). Ives (2007) examined using graphic organizers in mathematics for word problems to improve accuracy. Twenty-four high school students instructed in the use of a three-tiered graphic organizer (i.e., eight participants were SWD) were instructed to solve multiple-step word problems. The three-tiered graphic organizer had three sections for students to solve each step of a word problem separately. Pretests were administered before the three-week intervention. Post-test results showed students who received instruction on graphic organizers outperformed students who did not receive instruction using graphic organizers. The students who used the graphic organizer had a better understanding of the conceptual foundations for solving linear equations versus students who did not use a graphic organizer in their mathematics class. Outcomes supported the use of the graphic organizer to help improve student performance on linear equations in algebra. Graphic organizers were one of many instructional strategies included in the instructional setting factor contained in the Conceptual Framework (Figure 2.1) to illustrate the importance of implementing the instructional approach to improve student learning.

The organization of pictorial materials in the mathematics courses, in particular, using graphic organizers, can provide help for solving abstract mathematic equations. A study by Witzel et al. (2003) implemented graphic organizers in mathematics with sixty-eight (34 were SWD) sixth and seventh-grade students. The students learned how to use a graphic organizer for solving algebraic transformation equations following the Concrete to Representational Approach (CRA) of instruction. Statistically significant outcomes from the posttest supported using the graphic organizer to improve student performance on mathematics word problems. The mean posttest score improved by seven points compared to student performance on the pretest. In a review of both studies, Witzel et al. (2003) and Ives (2007) supported using graphic organizers for SWD to improve content comprehension for solving word problems in mathematics.

In summary, the instructional setting was a factor included in the Final Conceptual Framework to incorporate instructional strategies such as concrete manipulatives, visual models, and virtual manipulatives as methods to support the of algebra achievement for SWD. Each of the instructional strategies provided evidence when implemented over a period of time it could strengthen comprehension of algebra concepts and produce positive outcomes (Jez & Wassmer, 2015; Maccini & Gagnon, 2006). Another factor located on the Final Conceptual Framework was the factor of pacing. Pacing for either the 1-year or 2-year algebra course represents the number of instructional days spent on instruction of the required algebra concepts. The factor of time was crucial in providing the initial instruction, instructional interventions, and necessary supports to help struggling students comprehend algebraic concepts. More instructional time to provide more initial instruction for algebra curriculum concepts and extended practice activities are important to support student comprehension to achieve algebra proficiency. Research indicated that testing accommodations, graphic organizers to solve word problems, smaller class size, and Resource Room placement all contributed to student success in algebra. The 2-year algebra course intervention incorporated these practices during the duration of the course.

Table 4.1

Overview of Graphic Organizer Studies

Study	Purpose	Sample	Design	Findings
Ives (2007)	The study examined using a graphic organizer (three-tier design) to improve comprehension of algebra questions.	A group of 24 students. The group included students with disabilities.	Experimental group design	Students who used graphic organizers on the assessment had higher scores on posttests than those who did not use the graphic organizer.
Maccini and Ruhl (2001)	Describing the importance and benefits to using the STAR strategy to improve students with disabilities performance in algebra.	Focus on three secondary students with mild disabilities.	Case Study group design	Findings indicated using the STAR strategy increased students' success solving word problems.
Witzel, Mercer, and Miller (2003)	Examining the benefits of graphic organizers with CRA sequence.	Thirty-four matched pairs of grades six and seven students (10 teachers, 12 classes). The group included students with disabilities.	Experimental group design	Significant findings for students who learned to solve problems with a graphic organizer on algebraic equations.
Zollman (2012)	Implementing the four corner and diamond graphic organizer to support student proficiency in word problems.	186 middle school mathematics students and nine teachers	Experimental group design	Students who used the four corners and a diamond graphic organizer strategy performed better than peers who did not use the organizer on a posttest.

Table 4.2

Quality Indicators for Graphing Organizer Studies

	Ives and Hoy (2003)	Ives (2007)	Maccini and Ruhl (2001)	Witzel, Mercer, and Miller (2003)	Zollman (2012)
Participants	1	1	1	1	1
Described sufficiently to replicate	1	1	1	1	1
Selection described sufficiently to replicate	1	1	1	1	1
Setting described sufficiently to replicate	1	1	1	1	1
Dependent variable	1	1	1	1	1
Dependent variable described sufficiently to replicate	1	1	1	1	1
Quantifiable	1	1	1	1	1
Measurement valid and described sufficiently to replicate	1	1	1	1	1
Measurement occurred repeatedly	1	1	1	1	1
Independent variable	1	1	1	1	1
Independent variable described sufficiently to replicate	1	1	1	1	1
Procedural fidelity measured and described	1	1	1	1	1
Baseline	0	1	1	1	1
Conditions described sufficiently to replicate	0	1	1	1	1
Experimental control/Internal validity	1	1	1	1	0
Three demonstrations of experimental effect	1	1	1	1	0
Design controlled threats to internal validity	1	1	1	1	1
External validity	1	1	1	1	1
Effects replicated across participants	1	1	1	1	1
Social Validity	1	1	1	1	1
Dependent variable socially important	1	1	1	1	1
Magnitude of change in dependent variable due to intervention	1	1	1	1	1
Independent variable is cost-effective	1	1	1	1	1

Note. Quality Indicators were used, as proposed by Horner, Carr, Halle, McGee, Odom, and Wolery (2005). 0 = No; 1 = Yes.

Discussion and Conclusion

Creating a standardized and rigorous diploma might influence SWD's performance in mathematics. Making algebra a requirement for graduation was similar to making many high schools assess what instructional and testing accommodations were needed to promote the students' proficiency in algebra. The creation and implementation for the 2-year algebra course needs to include course elements to provide a supportive learning environment to include a slower instructional pace (Jez & Wassmer, 2015; Jones & Hensley, 2012; Patall et al., 2010), small class sizes (Ellerbrock & Kiefer, 2013; Feigenbaum & Friend, 1992), manipulatives (Maccini & Gagnon, 2006), visual models (Artus & Dyrek, 1989; Butler et al., 2003), and instructional strategies (Foegen, 2008; Hunt & Little, 2014).

The algebra course student enrollment should be small to provide students the needed individual attention to comprehend the algebra concepts (Ellerbrock & Kiefer, 2013; Feigenbaum & Friend, 1992). Slower instructional pace and more instructional time were suggested to provide more opportunities in the algebra course for students to successfully learn and demonstrate algebra proficiency (Jez & Wassmer, 2015; Jones & Hensley, 2012; Patall et al., 2010). Using manipulatives (i.e., virtual and concrete) were proven beneficial in teaching the rigorous algebra content to struggling learners (Maccini & Gagnon, 2006). Studies in the review of literature recommended strategies to help students to comprehend and retrieve algebraic concepts successfully (Roediger and Butler, 2013). Using instructional mathematics strategies in the classroom can support student achievement to comprehend, store, and apply academic content successfully (Foegen, 2008; Hunt & Little, 2014). Implementing both concrete and visual models in mathematics courses showed improved mathematical achievement and comprehension for students (Artus & Dyrek, 1989; Butler et al., 2003; Fuchs, Powell et al., 2008; Fuchs et al., 2005; Witzel, 2005; Witzel, Mercer, & Miller, 2003). Each of the course elements examined in the review of literature were essential in a 2-year algebra course to promote student algebra performance

Questions to consider for the 2-year algebra course intervention included:

- How can a 2-year algebra course be structured with additional opportunities for mathematics concepts to support the SWD?
- What accommodations need to be included to support SWD to earn the algebra requirement successfully?
- What students' scores on the middle school mathematics assessments are preferred to develop the eligibility for enrollment for creating an algebra course to meet the needs of SWD?

Chapter 5. Intervention Procedure and Program Evaluation

Goals and Objectives

The needs assessment established a relationship between SWD who did not meet proficiency on the Grades Seven and Eight State Mathematics Assessment and those who did not meet proficiency on the final state algebra examination. Creating and implementing a 2-year algebra course option was designed to provide a smaller class size with additional instructional time and a slower pace for the course teachers (i.e., general and special education co-teachers) to teach the algebraic concepts to support SWD to meet proficiency on the final state algebra examination. The 2-year algebra course option would provide additional instructional time to instruct students at a slower pace and in a smaller class size to provide students the support to achieve proficiency in algebra.

Evaluation Question

Does the amount of time, 1-year versus 2-year, for an algebra course, have an impact on the passing rate for the final state algebra examination for SWD?

Method

The study examined the intervention of the development and implementation of a 2-year algebra course to support student proficiency on the final state algebra examination. The study examined if creating a course option with additional time may benefit students' comprehension of algebraic concepts. The evaluation question examined the hypothesis: There is no significance between the 1-year and the 2-year course for SWD on the final state algebra examination.

Research Question

What is the relationship between the algebra courses, 1-year and 2-year options, on the final state algebra examination scores? The research question is different from the evaluation question because the research question examined the data collection for a specific population. For this study, the research question examined the result of the final state algebra examination to determine if the 2-year algebra course improves the passing rate for SWD on the final state algebra examination. The evaluation question studied the effort to implement an alternative option for an academic course and if the new course was helpful for SWD.

Design

The mixed method evaluation design was used to address the research question (Collins, Onwuegbuzie, & Sutton, 2006; Creswell & Clark, 2011; Teddlie & Yu, 2007). Mixed methods design includes both the collection of quantitative and qualitative data to explore a research problem. Both quantitative and qualitative data collection provided rich, detailed findings to analyze the intervention of the 2-year algebra course. Qualitative data from interviews with the 2-year algebra course teachers provided the teachers' perceptions about the algebra course factors, student factors, and teacher factors. Quantitative data from the 2015 and 2016 examined student passing rate in both the 1-year and 2-year algebra courses for SWD on the final state algebra examination. The summative form of assessment of the final state algebra examination addresses the information included in the proposed study of a 2-year algebra course option for SWD (Loucks, 1983). The 2-year algebra course was a new course developed to support the state’s new high school graduation requirements for all students to pass both the algebra course and final state algebra examination to graduate from high school successfully.

Findings from the study analyzed the effectiveness of the 2-year algebra course and any improvements of the course, to allow the course developers to make any necessary accommodations and permit changes needed to be made to improve the passing rate for students in the 2-year course option on the final state algebra examination for the next school year (Rossi, Lipsey, & Freeman, 2004; Wholey, Hatry, & Newcomer, 2010). The quantitative data analyzed test performance on the final state algebra examination for June 2015 and June 2016 for students (i.e., all classified as special education) enrolled in the 2-year algebra course.

Instruments

Students took the final state algebra examination in June after completing Year Two of the 2-year algebra course. The final state algebra examination entailed a three hour, state, standardized assessment administered throughout the state on a set day and time. The format of final state algebra examination included word problems. There were four sections of the examination. Section One entailed a multiple-choice section with 24 questions. Sections Two, Three, and Four were extended response questions. There were 37 questions on the three-hour examination equaling to a total raw score of 86 points. The converted raw score was a 100-point scale score (i.e., the raw score of 86 points equals a scale score of 100 points). The scale score is the student’s final score on the final state algebra examination.

The final state algebra examination was scored by certified high school mathematics teachers who went through training on how to score each section of the exam. Course teachers were not allowed to grade their students' examinations. Examination results were audited by state education officials to check for the accuracy of grading for each student's examination.

Procedure

After examining the outcomes for student performance on the Grade Eight State Mathematics Assessment, SWD were selected for the 2-year course for grade nine. The student enrollment allowed the course teachers to have a tentative class enrollment number before the summer and start of the school year. The 2-year algebra course started with two teams of co-teachers, each teaching two to three sections of the course. Implementation of the course was in September of 2013. June 2016, there was two years of the final state algebra examination data from students the 2-year algebra course.

The measurement tool used to quantify the students' mathematics achievement was the final state algebra examination. Both the dependent and independent variables as provided the study with a method to evaluate the success of the 2-year algebra course intervention. The purpose of the measurement tools was to examine the outcomes of student performance and how it impacted the focus of the study.

Dependent variable. The dependent variable was the scores from the student participants on the final state algebra examination administered during the third week in June.

Independent variable. SWD enrolled in the 2-year and the 1-year algebra course options represented the independent variables.

Participants

Participants for the study were algebra course students from one high school, who participated in either the 1-year algebra course or 2-year algebra course and took the final state algebra examination. Student performance on the 2015 and 2016 final state algebra examination provided documentation about the effectiveness of the implementation of a 2-year algebra course. Both the students' final state algebra examination scores and responses from the teacher participants provided data demonstrating the need for providing a 2-year algebra course option.

Algebra course students. The target population for the intervention consisted of SWD enrolled in the 2-year high school algebra course based on their failure on the Grade Eight State Mathematics Assessment. Exclusions for enrollment in the 2-year algebra course included (a) students who do not have a classification by the Committee on Special Education, (b) proficiency on the Grade Eight State Mathematics Assessment, and (c) students not entering grade nine. The 2-year algebra course was implemented in one suburban high school located in the United States. The enrollment for the 2-year algebra course ranged from 25 to 75 students per year. There was a maximum of 75 students (i.e., 15 students enrolled in each of the four-course sections) in the course. The enrollment figures were determined for SWD's failure on the Grade Eight State Mathematics Assessment. In 2013, 70 SWD did not pass the Grade Eight State Mathematics Assessment (SED, 2016c). In 2014, 47 SWD did not pass the 2014 Grade Eight State Mathematics Assessment (SED, 2016c). Some students, not meeting proficiency on the Grade Eight State Assessment remained enrolled in the 1-year algebra course option because of parental demand. Total enrollment in all combined sections for the 2-year algebra course needed to remain at least 25 (i.e., Cohen's $d = 0.25$) students to demonstrate potential significance of the intervention (Appendix S). The student participants in the treatment group enrolled 2-year algebra course students (N = 74), and the control group, 1-year algebra course students (N= 416) had a small significant sample size for power (i.e., Cohen's $d = 0.25$). The findings supported the measure for the magnitude of the treatment group size to further evaluate the success of improving the 2-year algebra course.

Twenty-five students for a study sample was categorized as a small sample size. The sample size was considered small, according to Cohen's $d = 0.25$ (Appendix S). Using data from the June 2015 final state algebra examination (SED, 2016c), 30 students in the 2-year course (i.e., 2015 treatment group) completed the assessment. The June 2016 final state algebra examination participants for the 2-year course consisted of 44 students (i.e., 2016 treatment group). Total treatment group size was 74 participants (i.e., 30 participants taking the final state algebra examination in June 2015 and 44 participants in June 2016).

Fidelity of implementation was traditionally defined as the determination of how successful "an intervention is implemented in comparison with the original program design during an efficacy and effectiveness study" (O'Donnell, 2008, p. 33). Examining the fidelity of implementation of the 2-year algebra course included the components of efficacy. The quality of delivery for this intervention included creating an option in response to the amended graduation diploma requirements in the identified state. Developers needed "to determine if the intervention will result in achievement of instructional objectives" (O'Donnell, 2008, p. 41). The instruction of the 2-year algebra course was by two teams of co-teachers, each teaching sections two sections of the course. Success for the 2-year program included demonstrating if the desired identified outcome of the intervention is accomplished. Time (i.e., weeks and days) allotment per algebra concept for the 2-year course needed to be followed by course teachers to support SWD to learn the algebra concepts successfully.

The goal of the intervention was to implement a 2-year algebra course for SWD to help them improve their chance to pass the final state algebra examination. Alignment for the Fidelity of Implementation on the Data Collection Matrix (Table 5.1) and the Logic Model 2-year Algebra Course (Appendix T) identified the students' performances on the final state algebra examination as key outcomes for the 2-year algebra course. The primary indicator of fidelity was the data collected from students' performance on the final state algebra examination enrolled in the 2-year algebra course option.

Teacher interviews. The researcher interviewed four teachers from the identified high school where she was formerly employed. These four teacher participants selected were the teachers for the 2-year algebra course. Each teacher was interviewed individually and their responses audio recorded. The identified school district granted permission for each teacher to discuss the 2-year algebra course intervention with the researcher (see permission letter in Appendix U).

The teacher interviews were used for qualitative data collection to provide rich responses to understand the challenges and achievements for implementing a 2-year algebra course option. The information collected from the teacher interview responses provided feedback about the 2-year algebra course instructional approaches and course design.

Data Collection

The researcher obtained the final state algebra examination results from the mathematics department chair. Access to the final state algebra examination results was available on the SED's (2016c) website from each school.

Students who did not successfully pass the first year of the 2-year algebra course would have an opportunity to repeat the first year (i.e., Year One) during the next academic year. The identified high school and developers of the 2-year course would allow these students to remain enrolled in Year One and Year Two of the course at the same time. Algebra concepts are sequential and each concept builds on the learning from prior concepts instructed in the algebra course; however, the developers for the algebra course decided to provide students the option to enroll in both Year One and Year Two algebra courses concurrently in the event a student does not pass the Year One course and needs to repeat the Year One course. Students need three mathematics credits to graduate from high school (SED, 2016c) and for students to be able to earn the three mathematics course credits in the event one mathematics course is not passed, a student will be permitted to enroll in two mathematics courses concurrently. In this study, no students fell into this category and needed to take both Year One and Year Two concurrently. Two factors might influence student withdrawal from this intervention. One, the severity of a student's disability may not support the student succeeding, therefore, the student is placed in a life skills program and to prevent students from dropping out of high school.

Quantitative Data Analysis

Student outcomes in the June 2015 and June 2016 were analyzed using an independent samples *t*-test and the ANOVA Brown-Forsythe Test of Equality of Means for findings. The Brown-Forsythe Test was used to test the hypothesis for two groups who do not have equal means. The scores on the state algebra final examination for SWD (SE) and who were in the 2-year algebra course were compared with those SWD in traditional the 1-year algebra course. In addition, the state algebra final examination scores for all students enrolled in the 2-year algebra course were compared to those in the 1-year course.

Summary Matrix

The alignment between the study's research questions, variables, and data collection procedures is illustrated in Table 5.1.

Table 5.1

Data Collection Matrix

Fidelity Indicator	Data Source	Data Collection Tool	Frequency	Responsibility
Dose-Results of the algebra course final state exam for students enrolled in the 2-year algebra course.	Final state algebra examination scores for students in the 2-year course.	Results of the final state algebra examination for June 2015 and 2016.	Data will be collected in late June after the exam is taken and scored.	The researcher will obtain the final state algebra examination results from the teachers of the 2-year algebra course and the mathematics department chair.
The Quality of Delivery-Results of the algebra course final state algebra examination for special education enrolled in the 1-year algebra course at the identified high school. This indicator is the control for the treatment condition.	Final state algebra examination.	Results of the final state algebra examination scores from 2006 to 2012, 2015 and 2016.	Data was collected and is included in the results section.	Same as the column above.

Note. Fidelity Indicators were used as proposed by Dusenbury et al. (2003).

Strengths and Limitations of Design

An important strength for using a quantitative data source from the final state algebra examination was because it entailed an objective assessment, scored, and scaled by trained, non-course teachers and state auditors oversaw the administering and scoring of the examination. The outcomes for the student performance of the final state algebra examination provided an independent evaluation regarding the intervention of the 2-year algebra course.

Enrollment in the 2-year course remained limited to SWD entering grade nine who did not meet proficiency on the Grade Eight State Mathematics Assessment, which excluded general education students who did not meet proficiency on the Grade Eight State Mathematics Assessment. SWD who passed the Grade Eight State Mathematics Assessment, but with a low passing score, were not eligible for the 2-year algebra course option.

Outcomes from a research study are useful if the findings can be accurately and confidently interpreted. Correct inferences need to be presented about the research findings of the study or if a cause and effect relationship can be determined. The accurate interpretation of the findings includes the study's potential external and internal threats. Identification of aspects in the study that may impact the reliability are the limitations. The student failure of one of the two years of the algebra course and student drop out from school was a potential internal validity threat of attrition that could influence the declining course enrollment. Attrition as a threat to internal validity was the loss of a student enrolled in the 2-year algebra course option, therefore, the student was removed from the study. Without a specific number of students enrolled in the 2-year algebra course, the effect size (i.e., minimum of students needed to participate in the study) to analyze the findings for the study may be impacted by the overall findings for the achievement for the 2-year algebra course. Students in the 2-year course participated in earning the algebra credit needed for graduation (SED, 2016b). Guidance counselors and IEP managers met with students individually during June of grade eight to discuss course selections and the credits necessary for graduation. At the June meeting, counselors presented the rationale for the 2-year algebra course, so students were motivated to participate in the new course offering.

A plausible cofounding variable was a testing effect. The testing effect factor is a threat to internal validity because being familiar with a test can influence the performance on the second testing. The performance on the second testing can impact the findings on the test. Students became familiar with the test format and questions, which might result in positive performances on the assessment because of familiarity (Shadish et al., 2002). However, as discussed earlier in the study, the needs assessment responses from the teacher interviews explained the challenge for SWD retaining mathematics content from year to year. Providing opportunities for students to retrieve prior mathematics concepts and solve algebraic equations included in the final state algebra examination was strongly recommended to prepare students to achieve proficiency on the examination. A threat to construct validity included the inability to have a clear explanation for the average growth of SWD for an average school year (Shadish, Cook, & Campbell, 2002). Each student with a disability, enrolled in the 2-year algebra course, had varying learning differences influencing their rate of learning. Lastly, the selection threat to internal validity examined if the participants each had an equal chance to being placed in the control or treatment groups and if the students were comparable to other student participants. The final state algebra examination scores for the students enrolled in the 2-year algebra course did not consider the varying subcategories of learning disabilities, and SWD may have different disabilities that may cause a need for more instructional support to learn and retain academic concepts.

A final limitation of the study design was the selection treatment interaction threat to external validity. The threat of selection treatment interaction validity considers the chance that the characteristics of the student participants (i.e., learning concerns and prior experiences) included in the study may impact the inability to scale up the intervention. External validity considers the possibility the study's findings are able to be generalized for the group of participants in the study. The precisely defined, eligibility for enrollment criteria for the inclusion in the 2-year algebra course has to be followed to examine the findings for the intervention's outcome evaluation question (Shadish et al., 2002).

2-year Algebra Course Elements

In response to the updated requirement for all high school students to earn an algebra credit (i.e., passing both the algebra course and final state algebra examination) for graduation from high school, important instructional approaches (i.e., instructional pace, teacher preparation) needed to be included in the creation of a 2-year algebra course option for struggling learners. The 2-year algebra course option was designed to provide the needed additional support for students to successfully pass both the algebra course and the final state algebra examination to earn an algebra credit (SED, 2016b). Elements of the intervention of a 2-year algebra course to support student learning included professional development learning sessions for course teachers on algebra topics and instructional strategies, common planning periods, course webpage, course syllabus, and communication with families and guardians. Table 5.2 provides a comparison between the 1-year and the 2-year algebra courses.

A planning committee was formed to explore options for SWD to help them meet the algebra credit requirement. Members of the committee charged with the creation and implementation of the 2-year algebra course included the superintendent for curriculum, director of special of education, department chair for mathematics, department chair for special education, high school principal, two middle school guidance counselors, two high school guidance counselors, two high school special education teachers, and two high school algebra teachers. The researcher was part of the planning committee to investigate ideas to support student achievement in algebra. Members of the planning committee visited four public high schools between 2004 and 2008 in the identified state to learn about practices the schools were successfully implementing to support student learning in mathematics; however, none of the schools were implementing a 2-year algebra course. Practices included a student learning center, different forms of co-instruction, and computer programs to provide extra support for learners. Additional discussions with experts in the areas of algebra curriculum and co-instruction from state universities provided suggestions to support student mastery. The planning committee developed the curriculum map (Appendix P) for the 2-year algebra course to mirror the curriculum map for the 1-year algebra course (Appendix Q), which aligns to the end of the year examination. Each of the instructed modules for the course included specific algebra topics.

Professional learning during the school year for co-teachers was provided as an opportunity for the 2-year algebra course teachers to meet with members of the planning committee to discuss course curriculum and objectives. This professional learning sessions allowed the teachers to examine the elements of the 2-year course and communicate with the planning committee about any potential concerns. Special education teachers were provided support during the professional learning sessions by algebra teachers. General education algebra teachers reviewed and explained in detail about the instruction of the algebra curriculum. During the training sessions, the course teachers reviewed the curriculum map and designed lessons to improve student comprehension of algebraic concepts. Successful strategies were taught to the co-teachers to implement in the extended course. Specific strategies presented included weekly reviews and graphic organizers for multiple-step word problems. Co-teachers of the course were given two staff development days during the school year to create and plan additional lessons. At the end of each school year, the co-teachers met with the planning committee to inform the group of any concerns and achievements of the 2-year course. During this meeting, the planning committee examined the elements of the 2-year algebra course to determine if any changes need to be made to improve the instruction of algebra concepts for students. A daily common planning period was included in each of the co-teachers of the 2-year algebra course schedules. The purpose of the daily, common planning period was to provide a dedicated time for 2-year co-teachers to plan lessons, grade assessments, communicate with parents and guardians, and discuss individual student's performance in the course. In addition, the co-teachers provided after-school mathematics support for students in their classroom for forty-five minutes. The after-school algebra help allowed students to get support for completing homework assignments and time to have the teachers reteach algebra concepts to support the student's understanding for algebra curriculum concepts.

Access to the internet to reference course elements on a course's web page was beneficial to support student achievement. Each algebra course (i.e., 1-year, 2-year) at the identified high school has a webpage to provide relevant information (i.e., course assignments and objectives) to guardians and students. On the opening day of school, the 1-year and 2-year course teachers reviewed the course webpage, grading, and course syllabus with students. Content included on the course webpage were email links for both teachers, daily homework assignments, weekly review assignments, link to the electronic grade book (i.e., Student Portals), an online link for the course textbook, and additional links (e.g., YouTube videos) to support student understanding of algebra concepts.

Table 5.2

1-year and 2-year Algebra Course Comparison

Course Elements	2-year Algebra Course	1-year Algebra Course
Co-teaching	All course sections	Only course sections with 15% or greater SE enrollment
Algebra Learning Standards	All course sections	All course sections
Curriculum Map	Includes all 1-year Algebra Curriculum Map Modules with double instructional time (Appendix P)	1-year Algebra Course Curriculum Map (Appendix Q)
Final State Examination	All course sections	All course sections
Instructional Time	Two academic years	One academic year
Professional Development for Teachers	All course teachers	All course teachers
Test-taking strategies	Consistently provided	Inconsistently provided
Class Size	Approximately 15 students	Approximately 26 students
Homework	Three pre-assigned days	Three pre-assigned days
Algebra Textbook	Same book as 1-year course	Same book as 2-year course
Grading Procedures	Same as 1-year course	Same as 2-year course
Algebra Lab	One weekly class period	One weekly class period
Course Web Page	All course sections	All course sections
Guardian Communication	Phone call and email	Phone call and email
SWD Testing Accommodations	All course sections	All course sections
After-school support	All course sections	All course sections
Graphing Calculator Instruction	All course sections instruct and model how to use	Minimal to no instruction provided during the course

Algebra Curriculum

The 2-year Algebra Course Curriculum Map (Appendix P) includes required algebra topics for the algebra course and the required end of year examination. Six modules were included on the curriculum map and the number of instructional days, including individual topics to be instructed for the 2-year algebra course (Table 5.3). The 1-year algebra course includes the same topics; however, the instructional days assigned to each topic were half the instructional time provided in the 2-year algebra course (Appendix Q). Module One devoted 80 instructional days (i.e., 40 instructional days in the 1-year algebra course) on the relationships between quantities and reasoning with equations and graphs. Topics instructed in this module were solving an equation, translating between various forms of linear equations and inequalities, creating equations in two variables to represent relationships between quantities, factoring of equations and polynomial expressions and adding, subtracting, and multiplying polynomial expressions. The first module had 28 lessons that cover four topic areas: Introduction to Functions, Structure of Expressions, Solving Equations and Inequalities, and Creating Equations to Solve Problems.

Module Two included 50 days (i.e., 25 instructional days in the 1-year algebra course) of instruction on descriptive statistics. Primary topics instructed in this module were interpreting variability in data, calculating conditional relative frequencies, and organizing data on two-way frequency tables. Additional algebra topics included in the module were histograms, box plot distributions, absolute deviation, and standard deviation. The second module had 20 lessons on four topic areas: Shapes and Centers of

Distribution, Describing Variability and Comparing Distributions, Categorical Data on Two Variables, and Numerical Data on Two Variables.

Module Three included 70 days of instruction (i.e., 35 instructional days in the 1-year algebra course) on linear and exponential functions. Topics instructed in this module were exponential functions, range, domain, and the interpretation of functions presented graphically, numerically, and symbolically. The third module had 24 lessons for the four topic areas: Linear and Exponential Sequencing, Functions and Their Graphs, Transformations of Functions, and Using Functions and Graphs to Solve Equations (SED, 2016a).

Module Four included 60 days (i.e., 30 instructional days in the 1-year algebra course) of teaching polynomial and quadratic expressions, equations and functions. Topics instructed in this module are quadratic functions, square root functions, cube root functions, and translating forms of linear equations and linear and exponential functions. The fourth module had 24 lessons on the topic areas: Quadratics Expressions, Equations, Functions and Their Connection to Rectangles, Using Different Forms for Quadratic Functions, and Function Transformations and Modeling (SED, 2016a).

Module Five focused on the algebra topic of synthesis of modeling with equations and functions for 40 days of instruction (i.e., 20 instructional days in the 1-year algebra course). Topics instructed in this module were graphing functions and interpretation of the parameters of an equation. The module has nine lessons for the two topic areas: Elements of Modeling and Completing the Modeling Cycle (SED, 2106a).

Module Six included 60 instructional days (i.e., 30 instructional days in the 1-year algebra course) for review for the mid-course and final state algebra examinations. The review module provided the opportunity to present previously given end-of -year examinations to students to practice solving items, so they experience the format and rigor of questions on the final state algebra examination. Student performance on previous examinations provides feedback to course teachers regarding areas students need additional support to meet proficiency. The Module Six instructional days were divided into four sections during the 2-year algebra course. Sections one and three were each 10-days of lessons presented during the final two weeks of the second grading quarter (i.e., January). Sections two and four were 20-days of lessons presented during the final two weeks of the fourth grading quarter (i.e., June). Students take the end-of-year algebra examination at the end of the 2-year course in mid-June.

Table 5.3

2-year Algebra Course Modules and Topics

Modules	Topics	Instruction Days
Module One	Relationships between quantities Reasoning with equations and graphs	80
Module Two	Interpreting variability in data Calculating conditional relative frequencies Organizing data on two-way frequency tables	50
Module Three	Linear and exponential functions	70
Module Four	Polynomial and quadratic expressions, equations, and functions	60
Module Five	Synthesis of modeling with equations and functions	40
Module Six	Review for the mid-course and final state algebra examinations.	60

Algebra Instructional Supports

Teachers planned for and used graphing calculators, manipulatives, and graphic organizers to help students successfully solve multiple-step word problems. The format of the final state algebra examination and posttest assessments in the 2-year algebra course were word problems (SED, 2016a). Implementing the Four Corner and Diamond Graphic Organizer (Appendix R) with students helped support the students to organize the different tasks included in the word problem. After organizing the information from the word problem on the graphic organizer, students were able to solve for each step of the word problem. Using graphic organizers was modeled for students during the second lesson for the course. Students were encouraged to use the strategy to solve word problems successfully.

Mnemonics is a strategy that was first instructed to students during Module One, lessons three and four. PEMDAS (i.e., parentheses, exponents, multiply, divide, add, and subtract) and FOIL (i.e., first, outer, inner, and last) were instructional strategies used to support students solving algebraic equations accurately (Jeon, 2012; McNeil, Weinberg, Hattikudur, Stephens, Asquith, Knuth, & Alibali, 2010).) Use of mnemonics was supported and encouraged during the 2-year algebra course.

Students using physical objects (i.e., math counting blocks and algebra pattern blocks) and manipulatives were key instruction tools implemented in the algebra course to provide hands-on learning in the algebra course. The physical objects and manipulatives support students to visualize abstract algebraic word problems. Manipulatives were frequently used in the course to help students create a concrete image of an abstract algebra concept. Counting blocks and dice were used to help solve algebra equations. Students used different color markers to reinforce the steps for algebra concepts while solving a problem. The students used dry erase boards and chart paper in daily lessons during the duration of the 2-year course. In Module Two, when learning about histograms and box plots, mathematics counting blocks and algebra pattern blocks support the students’ ability to visualize the abstract algebra concepts to find a solution when solving algebraic equations accurately.

The graphing calculator was an important instructional tool used in the algebra course (Doerr & Zangor, 2000; NCTM 1989). The National Council of Teachers of Mathematics curriculum standards, *Principles and Standards for School Mathematics* (2000) document, promotes the use of graphing calculators to support student learning of mathematical content (NCTM, 2016). Graphing calculators were provided for all students in the class. At the beginning of the algebra course, the co-teachers provided time during the lessons to model the different functions on the graphing calculator as a procedure to improve the accuracy for solving algebra task. The co-teachers provided opportunities during the first two weeks of the course for the students to solve algebra problems using the graphing calculator. Throughout the duration of the algebra course (i.e., 1-year and 2-year), the co-teachers preferred that students use the graphing calculator to solve different algebraic tasks to achieve the correct answer accurately. Some of the algebra tasks assigned to students include graphing coordinates and solving for algebra translations and reflections for a series of coordinates. In the 1-year algebra course, teachers do not provide instructional time to model and explain the functions for using the graphing calculator. Encouraging the students to become familiar with the different functions on the calculator supported the students in more effectively using the technology of the graphing calculator to solve algebra problems accurately.

Course Grading Procedures

Grading procedures in the identified high school mathematics department were standardized for all mathematics courses. The grading procedures for students included the areas of participation, tests, labs, homework, and quizzes. Participation was 10% of the student's algebra course grade. Class participation was measured on class attendance, staying on task in class, and being prepared and on-time for class. Quizzes were given bi-weekly and were worth 30% of a student's algebra grade.

The algebra course implemented both pretest and posttests for each unit. A pretest was administered prior to starting a new unit. The 2-year algebra course teachers and other teachers in the mathematics department use the results of the pretests to evaluate student knowledge of skills being introduced in the next lesson. Post-tests were given at the conclusion of a unit within the modules of the course and are 20% of the algebra course grade. All post-tests were standardized within the high school mathematics department. Each course section was provided a specific form type for tests (e.g., Form B for 2-year algebra). This prevented students sharing specific question content on the test with students in other course sections.

Homework assignments were used in the algebra course to reinforce the instruction of algebraic concepts. Homework was 30% of the student's algebra grade. Homework for the algebra course was assigned three days a week (i.e., Mondays, Wednesdays, and Thursdays) and if a homework assignment was not completed, a student was required to stay after school with the course teachers to complete the assignment and receive zero credit. Another homework assignment was the weekly review. The weekly review was given to students every Monday and was due every Friday. The weekly reviews were eight mathematics problems from previous end-of-the-year algebra examinations. Completion of the weekly review assignment exposed the students to the terminology and rigor of questions on the final state algebra examination.

Students attended algebra lab one period per week outside of the algebra course and that contributed to 10% of the student's grade. During algebra lab, students reviewed topics covered in algebra class and completed a worksheet with 20 algebra problems. Completed student lab worksheets were submitted to the algebra course teachers. Benchmarks to monitor progress in the algebra course were the weekly reviews, the weekly algebra lab worksheets, and posttest performance. The mathematics department teachers used student performance in these areas to determine if adjustments were to be made in the delivery of instruction.

Guardian Communication

Guardian support was an important aspect for all mathematics courses. The algebra course teachers divide up the students enrolled in the course and made telephone calls to each student's guardian during the first week of school. The telephone conversation provided the opportunity for the teacher to introduce herself and discuss the course webpage, grading, objectives, and requirements of the course. During the conversation, the teacher provided email addresses for the teachers to encourage the guardian to contact the teachers with any potential concerns during the school year. Also, during the telephone conversation, the teacher invited the guardian to Meet the Teacher Night.

Providing opportunities for both the guardians and teachers to communicate about the learning and achievement for students in the 1-year and 2-year algebra courses were important. The algebra course teachers communicate (i.e., phone call, email, handwritten note) about positive achievement and behavior with the guardians of the students a minimum of twice a year.

Algebra Learning Standards

The algebra course (Table 5.2) indicates the required learning standards students were expected to demonstrate proficiency on during the instruction of the course. Student performance on topic test assessments, labs, and the final state algebra examination were aligned with specific Common Core State Standards. The State Learning Standards for algebra include four different domains to include 17 standards for Algebra, Numbers and Quality have four standards, Functions have 15 standards, and Statistics and Probability have eight standards (SED, 2016a).

The identified high school used a web-based program to be sure the students were achieving the State Learning Standards instructed and tested on the course assessments for all academic courses. The web-based program was developed by a state university in 2007 to support teachers to keep track of each student enrolled in their course meeting the Common Core State Standards in algebra and other required courses for a state high school diploma. Each algebra instructor had an account to identify students in each course section and the standards required to be instructed and successfully mastered for each module, topic, and the final state algebra examination. The students' results for each test, lab, and final examination were managed and matched to each Common Core State Standards for algebra using the state website.

2-year Algebra Course Lesson

In this section, a description of a sample 2-year algebra course lesson from Module One was presented. The lesson was lengthened from one to two instructional days in the 2-year algebra course to provide more time and academic support to help students understand the topic being instructed. The same lesson in the traditional 1-year course provides only one instructional day for student to learn the content. As discussed earlier in this chapter (Tables 5.2 and 5.3), Module One was dissected into four topic areas. Topic One was Introduction to Functions. An overview of the Topic One in Module One was to provide an opportunity for students to be introduced to and become familiar with functions that include linear, exponentials, and quadratics. This topic area contained five lessons to address each of the topics, and the duration of each lesson was two instructional days.

Lesson One included two instruction days on linear equations. The three mathematics state standards included in the Lesson One were: Use units as a way to understand problems and to guide the solution of multi-step problems. Second, define appropriate quantities for the purpose of descriptive modeling. Third, choose a level of accuracy appropriate to limitations on measurement when reporting quantities (SED, 2016a). Student Outcomes for Lesson One were students to state the accurate quantities from a situation, and interpret the scale, and graph a linear function. Students should be able to understand the relationship among physical measurements on a scale and how the measurement was interpreted on a graph. Lesson One's instruction begins with students watching a two-minute video using the classroom's in-focus machine. The video was a man a descending an outside staircase. Prior to showing the video clips, students were asked to write down what is motion and what does it look like? After watching the video, students were actively involved in a large group discussion about the concepts of speed, distance traveled over time, change of elevation, and how the video pertains to those topics. The special education teacher called on students to share their responses and the general education teacher recorded student responses on an overhead projector screen for the students to examine shared ideas. Both teachers asked the students three questions to consider: (a) How high do you think the man was at the top of the stairs; (b) How can you estimate the elevation of the man descending the stairs; and (c) Did the elevation of the man change? Students were given five minutes to respond to the three questions. The general education teacher modeled creating *x* and *y*-axes on a graph and discussed with the students the task of trying to graph the descent of the man from the video. For the vertical axis, the students were asked by the co-teachers what should be the selected unit of measurement (i.e., meter, miles, feet) and what should the label be on the horizontal axis (i.e., seconds, minutes, hours)? The general education teacher properly labeled and modeled how to create the graph to examine the motions of the man descending the stairs. Students were asked by the co-teachers to draw on their individual dry erase boards where the man at the top of the stair's placement was located on the graph and to estimate the overall shape of the graph when placing the data on the graph. Both teachers moved throughout the classroom to observe students working independently. After students were finished and student volunteers shared the recorded information, the teachers placed the students in pairs to create the graph for the man's movement on chart paper. At the conclusion of Module One, Lesson One, the students completed the exit ticket by answering a question about how they would describe the graph they created to demonstrate learning about the man's movement to include height and distance on their graphs.

The first lesson on the second instructional day, the teachers replayed the video and asked students to justify why the graph at the conclusion of the video was correct or incorrect. The students discussed the height and described the distance for each measurement on a graph (i.e., miles are too long a distance to measure the man's elevation). In groups of three, students were given a handout with questions to answer about to the video clip of the man descending the stairs. Students examined the sample graph on the handout that represents the video of the man's motion descending the stairs to interpret what the graph represents. Then students are asked, "Why is one part of the graph steeper than the other?" Question three, does the slope in each line segment represent the man's elevation during motion? After each group completed the assignment, one member of the group read the group's answers and submitted the handout to the co-teachers. Next, the students watched a short video of a man climbing a ladder. Each student created a graph representing the motion of the man using time and distance. Students were given graph paper and class time to work on the assignment. The assignment was due at the end of class. The task for the exit ticket included each student in the class to interpret the nine-time intervals for the man climbing the ladder from the video. The exit ticket was submitted to the teachers at the end of Lesson One, Day Two. In the 1-year algebra course, this lesson would be one instructional day with minimal instructional time for the students to solve algebra equations and receive feedback from the course teachers. Students would not be provided more opportunities the next instructional lesson to practice and reinforce the concept instructed from the previous lesson.

Discussion

In summary, the leadership assigned to implement the intervention of a 2-year algebra course selected which SWD should be placed in the proposed course. Potential students to be eligible for enrollment in the 2-year algebra course were SWD who were entering grade nine and did not pass the Grade Eight State Mathematics Assessment. The findings from the chapter three needs assessment support the relationship between SWD who fail the Grade Eight State Mathematics Assessment fail the final state algebra examination. Once students were assigned to the 2-year algebra course, the school and teachers needed to provide instruction on key algebra concepts to support students' attainment of proficiency in algebra.

Findings from the data collection of student outcomes on the final state algebra examination and teacher interviews will provide details about the effectiveness of the implementation of the 2-year algebra course. The passing rate percent for the students enrolled in both the 2-year and 1-year algebra courses will provide quantitative data to demonstrate the success of the 2-year algebra course. The purpose of conducting teacher interviews with teachers of both the 2-year and 1-year algebra courses were to provide rich details about the strengths and limitations of the implementation of the 2-year algebra course.

Final Conceptual Framework

The Final Conceptual Framework represents the problem of practice, the proposed solution, the factors, and measurements to understand the relationships for implementing the algebra course for SWD was the focus for the study. The problem of practice was one type of high school diploma available in one northeastern state in the United States. Students must meet all of the high school requirements to graduate from high school (SED 2016b). Currently, one of the diploma's requirements was for all students to pass both the algebra course and the final state algebra examination to receive a high school diploma. The focus of the study was the impact the new graduation requirement of algebra had on SWD (Steele, 2010).

All identified SWD entering grade nine were enrolled in an algebra course. Students were enrolled in the algebra course for grade nine in response to the graduation diploma requirements who required all SWD to the same standard of performance as general education students (Steele, 2010). Many SWD enter the algebra course in grade nine without successfully passing middle school mathematics and not meeting proficiency on the Grade Eight State Mathematics Assessment.

The study examined whether there was a relationship between the Grades Seven and Eight State Mathematics Assessments achievement for how SWD performed on the grade nine final state algebra examination. This study examined student performance on the Grades Seven and Eight State Mathematics Assessments and the final state algebra examinations between 2006 and 2012 to examine the passing rates for SWD. In addition, teacher interviews provided details to explain why many SWD were not successful in algebra and provided suggestions to improve student outcomes. The proposed intervention was a co-taught 2-year algebra course that was developed to provide a slower pace, more instructional time, and a small class size (e.g., 15 students) to help students with a classification who did not pass the Grade Eight Mathematics Assessment achieve proficiency on the grade nine, final state algebra examination.

The last phase for the Final Conceptual Framework (Figure 5.1) for this study examined the problem of practice for the requirement for all SWD to pass the final state examination in algebra and the high school's solution of creating and implementing a 2-year algebra course to improve students passing the final state algebra examination

(Flavell, 1979; Schunk, 2008). The Final Conceptual Framework (Figure 5.1) identifies both the factors (i.e., ovals) and measurements (i.e., rectangles) of data used in the study. The Final Conceptual Framework builds on the initial Conceptual Framework (Figure 2.1) from chapter two to provide a visual representation of variables and factors impacting the creation of the 2-year algebra course. Two factors added to the Final Conceptual Framework were: 1) Eligibility criteria for SWD who did not meet proficiency on the middle school mathematics assessments 2) Challenges to the external policy factor represents the difficulty (i.e., student learning) schools and teachers had to achieve student algebra proficiency. Student performance on the final state algebra examination was one measure of whether the 2-year algebra course intervention was effective increasing the number of students with disabilities passing algebra. Educational leaders' examination of student algebra achievement determined if mandating the algebra course in high school was beneficial to prepare students for additional high school mathematics courses and college mathematics courses. Data measurements were the Grade Seven State Mathematics Assessment, the Grade Eight State Mathematics Assessment, teacher interviews, and the final state algebra examination. Each of these measurements together provided mixed methods findings to demonstrate the effectiveness of developing and implementing the 2-year algebra course. The assessment results provide findings to identify SWD who need to enroll in the 2-year algebra course as a result of not passing the Grade Eight State Mathematics Assessment. Results for the final state algebra examination and teacher interviews provided evidence and details for the effectiveness of the 2-year algebra course. The factors of time, pace, and class size were added to the Final Conceptual Framework to show the importance of these elements to be included in the 2-year algebra course. Each of the measurements provided data to support the development and implementation of a 2-year algebra course option to improve students with a classification achievement in earning an algebra credit required for a high school diploma.

As displayed on the Final Conceptual Framework (Figure 5.1), the factors and measurements each represent the relationships and confirm the study to implement the intervention, 2-year algebra course option. Both factors and measurements examined the success of the 2-year algebra course option.

<u>Final Conceptual Framework Factors (i.e., ovals)</u>

- High School Diploma: The ultimate goal for all high school students to achieve. Students need to pass the algebra course and final state algebra examination to earn a diploma.
- External Policy: *A Nation at Risk* (U.S. National Commission on Excellence in Education, 1983) and NCLB (2001) were educational policies that strongly recommended state education departments to increase the required number of mathematics courses taken in high school and the mandate to achieve proficiency in algebra to earn a high school diploma. This factor impacted the requirement mandated for students to earn a high school diploma. External policy influenced the factors of the high school diploma and challenges to external policy. As a result of the external policy, schools needed to implement the algebra requirement and promote student achievement in algebra.

- Challenges to External Policy: High schools needed to provide an algebra course to prepare students to pass the required state final algebra examination to attain algebra proficiency (DeBray, 2005; Mehta, 2013). SWD were required to earn proficiency in algebra (SED, 2016a). The challenges to the external policy factor impacted the issue of algebra achievement for SWD who were enrolled and mandated to earn algebra achievement. The algebra course needed to consider the varying types of learners required to enroll and pass the course and final examination.
- Algebra Achievement for SWD: Supporting the algebra achievement for SWD was important to produce passing outcomes for student achievement (SED, 2016a). To produce positive outcomes, the algebra course needed to implement key aspects (i.e., class size, pace, and time) to increase student learning.
- Policy Change and Factors: The policy change and SWD learning in the general education setting impacted the need to provide instructional approaches to improve SWD comprehension of algebraic concepts.
- Instructional Approaches: The 2-year algebra course was instructed by co-teachers and evidence-based practices were implemented to support student learning. The measurement of teacher interviews provided rich details to produce qualitative data to reveal specific methods implemented in the algebra course to influence student algebra achievement positively.
- Students Prior Mathematics Performance: Many SWD did not achieve proficiency on the middle school state mathematics examination. This

factor affected the algebra achievement for SWD striving to earn proficiency in algebra. The algebra course needed to provide strategies and additional support to reteach pre-algebra content for students who did learn foundational algebra concepts prior to enrollment in the algebra course.

- Algebra Course (i.e.,1-year and 2-year options): SWD selected from two options for the grade nine algebra course. Each of the course options was examined to determine if the 2-year algebra course had a larger number of students achieving algebra proficiency in comparison to the 1-year algebra course.
- Pace: The 2-year algebra course provided a slower pace with the additional school year to instruct the algebra course content in comparison to the pace of algebra concepts being instructed in the 1-year algebra course.
- Class Size: The number of students in the 2-year course was limited to 15 students per each class; however, the enrollment for students in the 1-year algebra course averaged 25 students per course section.
- Time: The 2-year course provided an additional academic year to instruct and support student algebra proficiency.

Measurement (i.e., squares)

- Final State Algebra Examination: A high school diploma requirement for students to pass the algebra examination measurement was connected to the factor of the algebra achievement for SWD. Students needed to demonstrate proficient skills on the final state algebra examination.

- Teacher Interviews: Teachers provided rich details about the 2-year and 1-year algebra course factors, instructor factors, and student factors to support the quantitative findings and course outcomes. Responses from the teacher interviews provided a deeper explanation about the instructional approaches provided in the algebra course options and the factor of algebra achievement for SWD. Students' achievement may influence the teacher interviews by providing evidence the teachers of the algebra course can share to elaborate on how students excelled or struggled to understand the course topics.
- Grade Seven State Mathematics Assessment: Students' scores were examined to determine if middle school mathematics performance relate to grade nine algebra performance.
- Grade Eight State Mathematics Assessment: SWD who do not pass the Grade Eight State Mathematics Assessment were recommended to enroll in the 2-year algebra course option. Both the Grades Seven and Eight State Mathematics Assessment measurements were influenced by the student prior mathematics performance factors. Student understanding and application of mathematical concepts were required to pass the state middle school assessments. Findings from the needs assessment show a relationship for SWD who did not pass the Grade Eight State Mathematics Assessment did not pass the final state algebra examination.

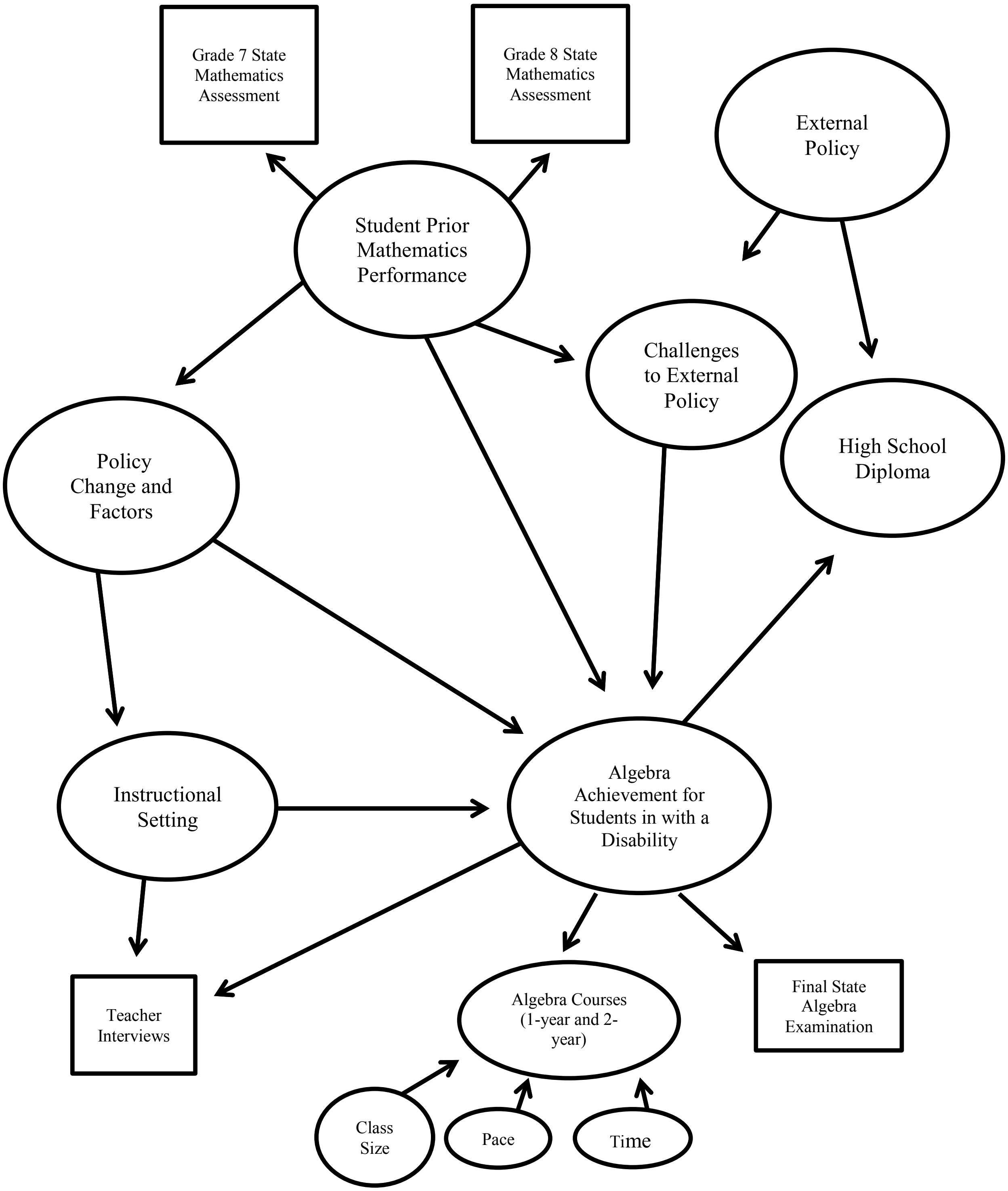

Figure 5.1. *Final conceptual framework.*

Chapter 6. Findings

Testing Data Pertaining to the Research Question

The purpose of the study was to assess SWD performance, after their participation in the 2-year algebra course, on the final state algebra examination in June 2015 and June 2016. Table 6.1 provides the overall final state algebra examination results for students enrolled in the 1-year and 2-year algebra courses. The name Sheridan High School is a pseudonym and is not the real name of the identified high school used in the study.

Table 6.1

Sheridan High School State Regents Algebra Examination Pass-Fail Results

Year	2015	2016
Total Students	225	265
1-year Algebra Course Students	195	221
2-year Algebra Course Students	30	44
Total 1-year Algebra Course Students Pass	141	185
Total 2-year Algebra Course Students Pass	15	27
Total 2-year Algebra Course Students Not Pass	15	17
Total 1-year Algebra Course Students Not Pass	54	36

Forty-two SWD who enrolled in the 2-year algebra course had passing scores on the final state algebra examination. The control group (i.e., 1-year algebra course) for the study was two times the size of the student participants in the treatment group (i.e., 2-year course), so the Brown-Forsythe Test of Equality of Means Findings for Performance was implemented to analyze the equality of group size variances using an analysis of variance test (ANOVA). The Brown-Forsythe Test was used to test the hypothesis for two groups who do not have equal means. As displayed in Table 6.2, the relationship between these variables in 2015 was not significant according the Brown-Forsythe Test of Equality of Means in 2015 (F (1, 223) = .05, p = .78), but was significant in 2016 (F (1, 263) = .05, p = .00). A total raw score of 86 points from 37 questions on the final state algebra examination equals a scale score of 100. The student's scale score was the student's final examination score. A scale score of 65 was the minimum passing score. The mean scores on the final state algebra examination for students with disabilities in the 1-year course was 65 (*SD* = 10) and 65 (*SD* = 7) for students in the 2- year course. The findings revealed statistical significance in 2016; however, statistical significance was not detected in 2015. In 2016, the mean scores on the final state algebra examination for the 1-year student performance was 73 (*SD* = 12) and 65 (*SD* = 14) for student performance from the 2-year algebra course. Mean and standard deviation for 2015 between the 1-year and 2-year algebra courses were remarkably similar. Meaning the enrolled students who passed with scores greater than the cut score of 65 did not pass by a comfortable or large margin (M = 65). Mean and standard deviation for 2016 between the 1-year and 2-year algebra courses show the 1-year algebra course passing scores fell much farther above the passing cut off score of 65. One possible explanation for the discrepancy for the 2016 1-year algebra course final state algebra examination results was because not as many SWD were enrolled in the 1-year algebra course (M = 73, SD = 12). As displayed in Tables 6.2

the relationships between the variables were only significant for 2016 and not statistically significant for 2015.

Table 6.2

ANOVA Brown-Forsythe Test of Equality of Means Findings for State Regents Algebra Examination Performance

	2015				2016			
Groups	N	Pass	*M*	*SD*	N	Pass	*M*	*SD*
1-year Algebra Course	195	141	65	10	221	185	73	12
2-year Algebra Course	30	15	65	7	44	27	65	14
N	225				265			
p-level	*p*= .78				*p*=.0			

Note. Passing score 65.

Both Tables 6.2 and 6.3 illustrate two findings: (a) more students were enrolled in the 2-year course for 2016 than 2015, and (b) passing performance on the final state algebra examination in the 2-year algebra course improved 11% from 2015 to 2016. The findings cannot detect any differences for the 2-year and 1-year algebra courses (Tables 6.3, 6.4, 6.5, and 6.6). While the findings for the 2015 examination were not statistically significant, when analyzed together, the 2015 and 2016 findings showed a possible relationship, indicating an increase for the passing rate of students taking the 2-year course

The performance for SWD's performance on the 2015 and 2016 final state algebra examination is displayed in Table 6.3. Forty-eight SWD in 2015 and 51 SWD in 2016 participated in the final state algebra examination. In 2015, only one student with a disability from the 1-year course passed the final state algebra examination, and in 2016, two SWD from the 1-year course passed the final state algebra examination. The passing rate on the final state algebra examination for SWD in the 1-year algebra course in 2015 was 5%, and in 2016, it was 28%. SWD enrolled in the 2-year course passing rate percentage was 50 (M = 62) in 2015 and 61 (M = 70) in 2016 (Tables 6.4 and 6.5).

Overall, Table 6.3 presents data for how SWD performed in both the 1-year and 2-year algebra courses for 2015 and 2016. In 2015, both algebra courses (i.e., 2-year and 1-year), the students did not score much above the cut score of 65. The findings in Table 6.3 shows for 2015 the 2-year algebra course students achieved more passing scores compared to SWD in the 1-year algebra course. Although these data were not found to be statistically significant, the findings cannot be generalized about student achievement in algebra courses.

Table 6.3

Sheridan High School State Regents Algebra Examination Findings for Students with a Disability

Year	2015	*M*	*SD*	2016	*M*	*SD*
Total SWD Students	48			51		
Total SWD Students Pass	16			29		
Total 1-year SWD Pass	1			2		
Total 2-year SWD Pass	15			27		
1-year Algebra Course Enrollment	18	52	15	7	63	5
2-year Algebra Course Enrollment	30	65	7	44	65	14

Note. Passing score 65; SWD=students with disabilities

The findings for SWD's performance on the 2015 final state algebra examination were exhibited in Table 6.4 for both the 1-year and 2-year algebra courses. In Table 6.4, an independent samples t-test was used because it required two variables; one must be categorical and have two levels, and the other must be quantitative and be determined by a mean. An independent samples *t*-test was implemented to analyze the relationship between student performance in the 2015 1-year and 2-year algebra courses for performance (i.e., pass or fail) on the final state algebra examination (Table 6.4). Outcomes from the independent samples *t*-test were not statistically significant (t =1.67, p = .76). In 2015, the mean score for the 1-year course for SWD was 52 (*SD* = 15), and the mean score for the 2-year course was 65 (*SD* = 7).

The findings in Table 6.4 show that 15 SWD in the 2-year algebra course passed the 2015 final state algebra examination and only one student with a disability who enrolled in the 1-year algebra course passed. The data was not found to be statistically significant, therefore, it cannot be generalized. In 2015, 94% of the 1-year algebra course SWD failed the final state algebra examination. The SWD enrolled in the 2-year algebra course achieved a 50% passing rate on the final state algebra examination.

Table 6.4

Independent Samples t-Test for Special Education Performance on State Regents Algebra Examination for 2015

Exam	Groups	N	Pass	Not Pass
State Regents Algebra	2015 1-year Algebra Course	16	1	15
State Regents Algebra	2015 2-year Algebra Course	30	15	15
t-test	1.67			
N	47			
p-level	p =.76			

Note. Passing score 65.

The 2016 final state algebra examination findings for SWD in both the 1-year and 2-year courses for the identified high school were presented in Table 6.5. Two of the seven SWD enrolled in the 1-year algebra course and passed the 2016 final state algebra examination. Twenty-seven out of 44 students from the 2-year course passed the 2016 final state algebra examination. Findings (Table 6.5) from the ANOVA Brown-Forsythe Test of Equality of Means were significant (p =.04). Mean score performance for the 1-year SWD was 53 (SD = 12), while the mean score performance for the 2-year course was 65 (SD = 14).

Table 6.5

ANOVA Brown-Forsythe Test of Equality of Means for Findings for Students with a Disability on the State Regents Algebra Examination for 2016

Exam	Groups	N	Pass	Not Pass	*M*	*SD*
State Regents Algebra	2016 1-year Algebra Course	7	2	5	53	12
State Regents Algebra	2016 2-year Algebra Course	44	27	17	65	14
N	51					
p-level	p = .04					

Note. Passing score 65.

The overall performance on the final state algebra examination for 2015 and 2016 for SWD in both the 1-year and 2-year courses was highlighted on Table 6.6. For 2015 and 2016, the total enrollment in the 2-year algebra course was 74 SWD. Forty-two of the 74 students passed the 2015 and 2016 final state algebra examination (Table 6.6) with a combined passing percent of 57% (M =65, SD = 11). Outcomes from the ANOVA Brown-Forsythe Test of Equality of Means for findings were statistically significant (p = .00). The student scores on the final state algebra examination showed 27 SWD from 2-year algebra course passed the final state algebra examination (Table 6.6).

After examining Table 6.5 for SWD performance on the 2016 final state algebra examination, the findings show 71% of 1-year algebra course SWD and 39% of students in the 2-year algebra course students failed the final state algebra examination. The number of students in the 2-year algebra course increased by 14 students (i.e., 44 students in 2016 and 30 students in 2015). In 2016 more SWD enrolled in the 2-year algebra course and these students showed a statistically significant increase in passing scores. The range of student test scores for the 2016 final state algebra examination in the 2-year algebra course was higher than the 1-year algebra course for SWD. In the 1-year course, the highest score achieved was a 65, which was the passing cut score. The 2-year algebra course students highest score achieved on the 2016 final state algebra examination was 79.

Table 6.6

ANOVA Brown-Forsythe Test of Equality of Means for Findings of Special Education Performance on State Regents Algebra Examination for 2015 and 2016

Exam	Groups	N	*M*	*SD*	Pass	Not Pass
State Regents Algebra	1-year Algebra Course	25	53	15	3	24
State Regents Algebra	2-year Algebra Course	74	65	11	42	32
N	99					
p-level	$p = .00$					

Note. Passing score 65.

The findings (Table 6.6) for SWD performance on the final state algebra examination did reach statistical significance ($p = .00$), SWD enrolled in the 2-year algebra course ($M = 65$, $SD = 11$) had more passing scores on the final state algebra examination compared to SWD enrolled in the 1-year algebra course ($M = 53$, $SD = 15$).

Table 6.6 presents the total performance for SWD enrolled in both the 1-year and the 2-year algebra courses for both the 2015 and 2016 final state algebra examinations. The 1-year algebra course reported SWD had a 12% passing rate and the 2-year algebra course had a 57% passing rate.

Interview Data Pertaining to the Research Question

The goal of the qualitative research results was to examine the feelings from teachers about the 2-year algebra course. Chapter five outlined the qualitative data examining four teachers from the identified high school who instructed the 2-year algebra course. Two of the four teachers are state licensed secondary mathematics teachers. The other two teachers are state licensed secondary special education teachers.

Prior to interviewing the four teachers, permission was provided by the school district's director of accountability and Johns Hopkins University IRB for approval to interviewing the teachers and the questions to be answered by the selected teachers. The goal for the teacher interviews was to have a thorough understanding of the elements built into the 2-year algebra course to make it different from the 1-year version. Each teacher was provided with an opportunity to provide details about the 2-year course intervention.

Teacher Participants

The four teacher interview participants were teachers for the 2-year algebra and 1-year algebra courses at the identified high school (Table 6.7). These four teachers were selected to provide important details about the implementation of the 2-year algebra course.

Table 6.7

Teacher Interview Participants

Teacher	Specialty	Teaching Experience	Co-Teacher Partner	Date Interviewed
Emma	Mathematics	23 years	Sarah	April 12, 2017
Judy	Mathematics	25 years	Janie	April 13, 2017
Janie	Special Education	13 years	Judy	April 12, 2017
Sarah	Special Education	12 years	Emma	April 13, 2017

Participant One. Emma is a state licensed secondary mathematics teacher in the identified high school for 23 years and was interviewed on April 12, 2017. Courses instructed by Emma include pre-calculus, geometry, and algebra (1-year and 2-year options). For 12 years, she has been the school district curriculum-learning specialist (CLS) in mathematics (i.e., school district chair for mathematics). Emma's position as a CLS has provided her the opportunity to become familiar with the state's revision of graduation requirements requiring an algebra credit for high school graduation for all students. Emma has been on many district committees who planned and developed curriculum for the 2-year algebra course. She also co-instructed the 2-year course from 2013 to 2017.

Participant Two. Sarah is a state licensed Kindergarten through grade 12 special education teacher in the identified high school for 12 years, and she was interviewed on April 13, 2017. For 12 years, Sarah has been co-teaching algebra and geometry and has co-instructed both the 2-year course and the 1-year algebra course from 2013 to 2017. Sarah and Emma have co-instructed the 2-year course from 2013 to 2016.

Participant Three. Janie is a state licensed special education teacher for 13 years, and she was interviewed on April 12, 2017. She has taught both middle and high school special education students in both self-contained and co-taught settings. Janie has been co-teaching geometry and algebra for seven years at the identified high school. Janie has been co-instructing the 2-year course from 2013 to 2017 with Judy.

Participant Four. Judy is a state licensed middle and secondary mathematics teacher in the identified high school for more than 25 years, and she was interviewed on April 13, 2017. Judy was a grade eight mathematics teacher for eight years prior to moving to the high school in 2001 to instruct the algebra course. Judy currently teaches algebra and co-taught algebra (i.e., 1-year and 2-year options). Judy has been on many district committees to plan and develop curriculum for the 2-year algebra course and has co-instructed the 2-year course from 2013 to 2017.

All high school teachers from the identified high school, participating in a co-taught course format attended professional development learning sessions. All four of the teachers (i.e., Emma, Judy, Janie, and Sarah) participated in school district professional development learning for co-instruction. Professional development learning sessions were provided during the summer and the academic school year to provide an opportunity to meet their co-instructor and plan the implementation of the co-instruction course. Additional professional development learning opportunities in the summer and during the school year were provided for teachers to implement the 2-year algebra course option. During the professional development learning opportunities, special education teachers were taught the major topics instructed in the algebra course to prepare the teachers to understand and teach the content to students. Mathematics teachers from the identified high school modeled to both co-teachers for the 2-year algebra course evidence-based strategies (i.e., Four Corners and a Diamond graphic organizer) to support algebra comprehension. The school district's curriculum learning specialist for special education presented a professional development learning session to the mathematics teachers discussing and implementing general accommodations (i.e., reduced homework assignments, large print textbooks, etc.,) and testing accommodations (i.e., reading tests to students, use of a graphing calculator, etc.) included in the IEP for SWD. In conclusion, the professional development learning opportunities provided the co-teachers time to become familiar with their co-teacher and to plan for implementing the course successfully to the students.

Overview of Analysis for Qualitative Coding

The goal for the collection and analysis of the qualitative data was to gather more in-depth information from the 2-year algebra course teachers to further explain the findings for the quantitative data in response to the research question: What is the relationship between students who take different length algebra courses, 1-year option and 2-year option, for SWD on the final state algebra examination? Quantitative data from the final state algebra examination produced statistically significant findings for combined final state algebra examination student scores for the two years (i.e., 2015 and 2016) the intervention of a 2-year algebra course option was created to help SWD achieve proficiency in algebra.

To collect information about the teachers' perceptions about the students' experiences in the different length algebra courses, four interviews were conducted with the only four teachers co-teaching both the 1-year and 2-year algebra courses. All teachers provided consent prior to the interview (Appendix U). Interviews were conducted individually from a predetermined set of 15 interview questions (Appendix V). A priori codes were developed prior to interviewing (Saldana, 2016) Prior to starting the analysis of the four teacher interviews; transcripts were uploaded to Dedoose (2017) for analysis. Each of the codes (i.e., emerging and a priori) connect to quotations from the four interviews. The teacher interviews provided 208 responses to provide more details about the 2-year algebra course (Appendix V). Interview Field Notes (Appendix X) provided a brief overview of teacher responses connected with coding themes. These four themes (i.e., course factors, student factors, instructor factors, and student summative assessment) provided a well-defined organization for identified themes to incorporate the rich response from the interviews.

The researcher read each of the four interview transcripts to connect responses to the a priori codes (Appendix T) and tagged the codes in the Dedoose software to reveal themes (Figure 6.1). When two or more responses represented an a priori code, the code was identified as a theme observed from the interviews (Saldana, 2016). The researcher also examined teacher responses from the interviews to identify emerging codes (Appendix W) (Saldana, 2016). From this analysis, emerging codes from the interviews were identified, including student assessment, inhibiting factors, and 2-year algebra goals. All identified emerging codes appeared at least twice within the transcripts (Saldana, 2016).

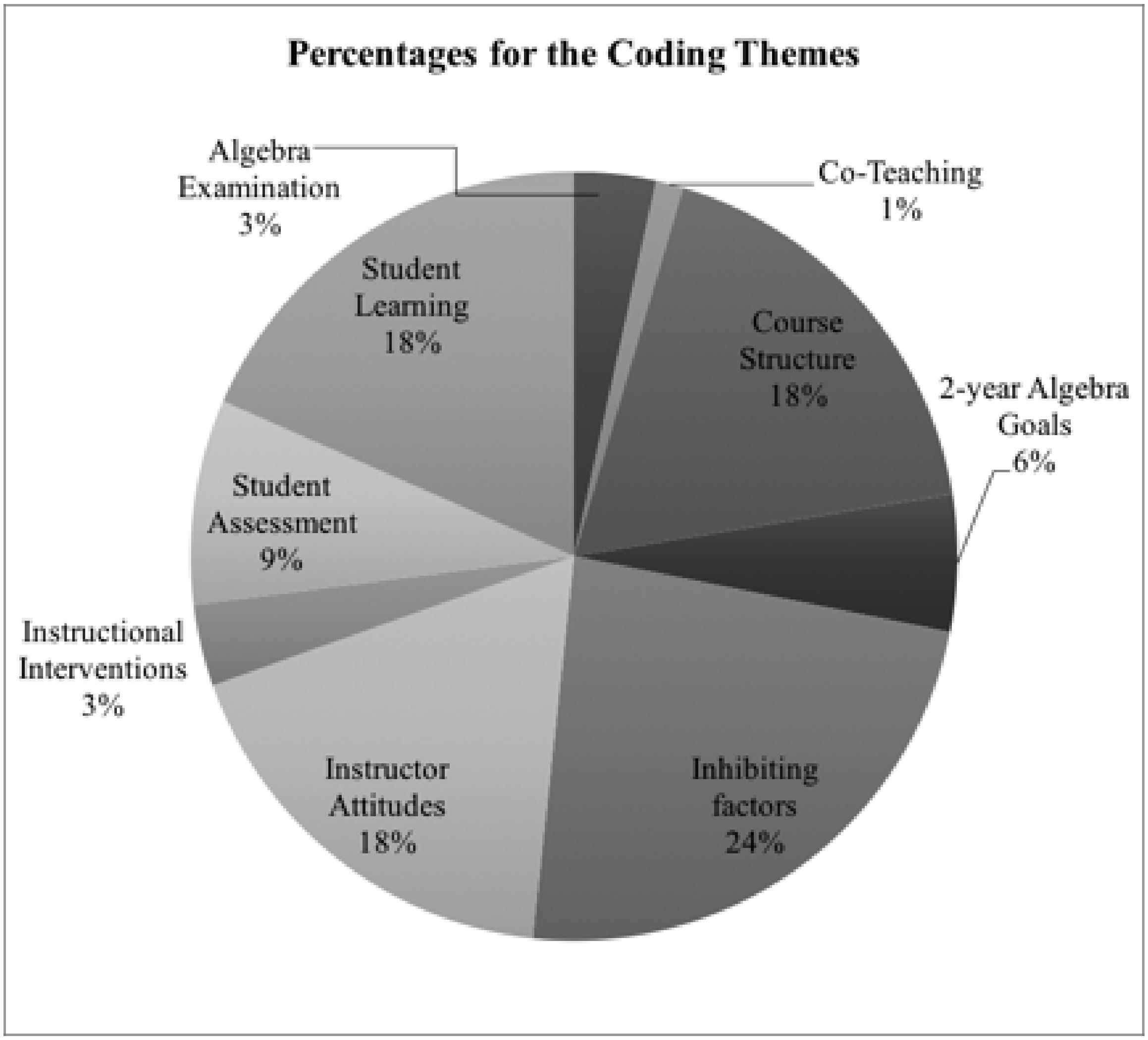

Figure 6.1. Percentages of the coding themes identified during the teacher interviews.

Themes

The analysis revealed four overarching themes including course factors, student factors, instructor factors, and student summative assessment. Within these overarching four themes, several sub-themes were identified.

Course Factors

The teachers' responses revealed data connected to concerns connected to the course delivery. Course factors included in this category include course structure, 2-year algebra course goals, co-teaching, and factors that inhibited successful course implementation, which was identified as inhibiting factors.

Course structure. The overall course design for the 2-year algebra course (i.e., pace, more instructional time) was important to the teachers and was discussed in detail by all four teachers. When asked questions about the similarities and differences between the 1-year and 2-year algebra courses, every teacher expressed the creation and development of the 2-year algebra course provided additional instructional supports to help student achievement in the algebra course. Janie praised the design of the 2-year algebra course:

> In the 2-year algebra course, the curriculum is the same, but it is modified, so the kids are really taught only what is necessary. The slow pace [allows the teachers] to make sure they fully understood the material. The [instruction] time in those smaller classes and smaller student-teacher ratio [provides the freedom] that if one strategy is not working, we can say why don't we learn it this way (I, April, 2017).

Janie revealed that the instructional interventions could be used in the 2-year course, but not in the 1-year course because other students in the course do not need the extra help. She explained her belief that slowing down the pace of the 1-year algebra course for struggling students would be problematic. Students who were not struggling might lose interest and would not be challenged. Teachers who slowed the pace of the 1-year algebra course curriculum may not be able to. teach all of the algebra topics which may not support future success. Janie also shared that a "2-year [algebra] course has a lot of test-taking strategies built within the structure of the curriculum (Table 5.2), and the course needs to stand the way it is" (Janie, I, April, 2017). Providing instructional time in the 2-year algebra course was beneficial for the students to prepare and review for the final state algebra examination. Sarah shared similar points about the need for additional instructional time to help students practice and review the algebra content learned in the 2-year course. Sarah explained:

> The slower pace allowed for more practice with the material for students in [supporting positive student outcomes on the final state algebra examination]. Algebra is a rigorous course, and the option to provide a 2-year algebra course with more instruction to support the success of students is important. In the 2-year course, there is enough time for you to repeat and practice [the algebra curriculum] (I, April 2017).

Judy shared:

> It is twice as much time spent on content with the 2-year course than the 1-year course, the lessons are the same, but there is more time for practice in the 2-year course. More [class] time [is necessary] to practice the [algebra] concepts to prepare students [for the final examination in the course] (I, April, 2017).

In addition to increased time, the teachers also noted the important algebra topics could be taught with greater depth. Emma shared the 2-year algebra course can "focus on a [single] topic at a time in those [mathematics weekly] reviews to really make sure that [the students] are demonstrating proficiency on a particular topic before [course teachers] move [on] to the next [topic] so that we know they have that topic secure" (I, April 2017). The teachers recognized the importance of additional time in the 2-year algebra course and the need to use that time strategically.

The teachers also noted algebra is more than just a course, but connects to other mathematics and science courses. Several teachers noted the importance for students to learn how to solve mathematical computations included in other high school science and mathematics courses. Emma explained,

> Algebra is the foundation for all of those other [high school mathematics] courses. It is the most important, so you have to make sure that you have those things secure if you are going to be successful moving on [to additional mathematics courses] (I, April, 2017).

In summary, the teachers support the creation and implementation of an algebra course that is two years long to support and improve student performance in algebra.

2-year algebra course goals. The school district including course teachers developed the 2-year algebra goals to address changes and recommendations to the current 2-year course intervention. Three goals identified by the 2-year algebra course committee to implement the 2-year course included (a) additional weekly period of mathematics instructional interventions, (b) implementation of a pre-algebra course for students to enroll in at grade nine to prepare the students for the rigor of the algebra curriculum, and (c) to improve the accuracy of placement for student enrollment in grade nine for algebra. The teachers revealed insight regarding the goals, particularly regarding student eligibility for the 2-year algebra course and recommendations to improve student achievement on the final state algebra examination. The teachers also indicated a need for additional instructional interventions because not all students receive Resource Room support. Janie, recommended, "providing remediation support for algebra similar to the mandatory mathematics remediation in the middle school" (I, April, 2017). Janie was referring to the school system middle school practice whereby students were provided a mandatory period of mathematics instructional interventions during the regular school day or after school. Emma also indicated that providing another "period during the day to review and reinforce algebra content [is needed for students to comprehend algebra concepts]" (I, April, 2017).

Three teachers, Emma, Janie, and Judy, discussed the option of creating a pre-algebra course for students to prepare them for the rigor of algebra. They expressed concerns that the knowledge of basic mathematics arithmetic computations needs to be instructed and mastered by students before enrolling in an algebra course. The 2-year algebra course is still an algebra course, and students need to be able to apply basic mathematics skills accurately to learn and develop the proficiency for the algebra curriculum. The teachers suggested the lack of a mathematics course that provides foundational knowledge for the students may directly impact their performance in algebra. Judy shared,

> A foundations course on pre-algebra curriculum concepts can prepare students for enrolling and successfully passing the rigor of curriculum concepts in the algebra course (I, April, 2017).

The teachers also had ideas about how to improve the 2-year algebra course. Jane discussed how teachers had offered possible suggestions within the algebra course to improve student achievement. Janie and Judy both suggested the 2-year algebra course should be separated into two mathematics courses. Grade nine would be a mathematics course about pre-algebra mathematics skills and then grade 10 would be the currently implemented 1-year algebra course. The grade nine pre-algebra course would concentrate on teaching the students pre-algebra concepts to prepare for the algebra course. Janie shared:

> [One teacher expressed the idea to improve the student achievement in algebra would be] to; change [the 2-year course option] to a 1-year course in algebra [for grade 10 students] or maybe [implement a required] a pre-algebra [course for students entering grade nine who would be enrolled in the 2-year algebra course] (I, April, 2017).

Judy expressed a similar concern. She explained:

> [If students are] having trouble in math their freshman year they should be in a fundamentals class, and then their sophomore year take the whole [1-year] algebra course (I, April, 2017).

Student placement in the 2-year course needs to consider the level of learning for each student to enroll the student in the correct algebra course option (i.e., 1-year or 2-year). Emma explained how the grade eight mathematics teachers, need to make accurate recommendations for enrollment of SWD in the algebra course options. Emma explained:

> This is why we have such a difficult time because if you are putting kids in a 2-year course, you are changing the course for the landscape of their transcripts for their time in high school, so you had better be sure and have a conversation with the parent that this is the right thing for that student because later on if they wanted to get to Algebra II or something higher like pre-calculus or calculus, they are going to have to double up in math (I, April, 2017).

Appropriate placement of the students was another concern offered by the teachers. Incorrect placement could impact the students' success. Emma discussed the challenge to remove a student who enrolled in the 1-year algebra course option when the student should be in the 2-year course per the enrollment eligibility criteria. The identified high school does not like switching students after the first couple of weeks of school. When teachers identify a student not properly placed in a course, it may take many meetings with administration to consider the change of a course. The school administration wants all students in challenging courses and often do not support a course change for a student. Emma stressed the importance of accurate placement for students in the algebra course options prior to the start of school.

Co-teaching. The theme of co-teaching connects to the overarching theme of course factors because co-teaching was a key course structure for both the 1-year and 2-year algebra courses. Co-teaching was a requirement of the 2-year algebra course implementation. The purpose of co-teaching is for both the general and special education teacher to equally collaborate to plan and implement the course curriculum. All four teachers interviewed teach the course with a co-teacher and responded favorably to the importance for having a co-teacher to support student achievement in algebra. The teacher participants shared effective key structures in the 2-year algebra course. Janie shared “two teachers [for the] algebra course is effective” (I, April, 2017). Janie explained, "Bringing in two teachers, as well, helps us talk about different strategies so there is the time in those smaller classes and smaller student-teacher ratio that if one strategy is not working, we can say why don't we learn it this way" (I, April, 2017).

Co-teaching, while required, was considered a benefit to all of the teachers. The two special education teachers considered their role as a key factor for successful implementation of the 2-year algebra course. Sarah explained how the pace of the 2-year course permits her to re-teach algebra concepts to students during the class. (I, April, 2017). The co-teachers provided differentiated instruction during the 2-year algebra course. Differentiated instruction allowed the teachers to accommodate the instruction of the lessons to support the learning needs of the students. Sarah shared the importance to accommodate the pace for students. Sarah expressed:

> For factoring quadratics, some of those students are not strong with their multiplication, so we may take time with understanding what factors are and looking at how to find the factors where that is not part of the curriculum itself. We take time to teach that vocabulary and give instruction as to what factors are and how to find them. (I, April, 2017).

Content for the 2-year algebra course was adjusted to accommodate the learning for the students. Janie shared how “bringing in two teachers, as well, helps us talk about different strategies” to provide meaningful instruction for students and their learning needs (I, April, 2017). In summary, both special education teachers view their role to improve student comprehension of algebra topics with more individual student support in the 2-year course to be important to support student learning.

Inhibiting factors. The theme of inhibiting factors identified course components that may negatively impact the successful, passing outcomes for students in the 2-year algebra course. These implications discussed by teachers in the interviews were students’ uneven school attendance, reading skills, input from grade eight teachers for placement in the appropriate algebra course option (i.e., 1-year, 2-year) and retention of curriculum concepts for two years. Students in the 2-year algebra course learn the required algebra topics over a two-year span and the challenge for the course was for students to retain and apply algebra content previously instructed. The focus for the interview question centered on challenging algebra concepts and student placement in the algebra course.

During the interviews with the 2-year algebra course teachers, it was discussed by Emma how placement in the types of algebra courses (i.e., 2-year and 1-year) was crucial. Emma explained the importance for grade eight teachers to be included in the decision for placement for students in either a 1-year or 2-year algebra course. Students need to be placed in a course to help them learn the curriculum content for algebra at a proficient level. Some students were placed in a 1-year algebra course when the student should be in a 2-year algebra course. Emma explained the importance of placing a student in the correct algebra option. Emma shared:

> In a 2-year program that [placement] can be a disservice to them because they were capable of more but they just sold out, for lack of a better term, and then took the easy route with their third-year math credit because the kids only need three credits and they have already gotten two in algebra (I, April, 2017).

Many SWD who were unsuccessful at passing the Grade Eight State Mathematics Assessment, chose to enroll in the 1-year algebra course instead of the option of the 2-year algebra course. The decision for the student to decline enrollment in the 2-year algebra course may influence both how successful the student will learn and apply the algebra concepts on the final state algebra examination. Also, this student may influence the 1-year algebra course by slowing down the instructional pace. The result may impact the students in the 1-year course who are not moving at the set pace of the course to complete the required curriculum instructed in the 1-year algebra course. Additionally, students who have the potential to succeed in a 1-year algebra course option need a chance to enroll in the 1-year algebra course. Students who are enrolled in the 2-year algebra course option should need the additional instruction time, slower pace, and small class size to get the help to pass the final state algebra examination.

The teachers expressed concerns about the students' who were enrolled in the 2-year algebra course and their efforts to successfully learn the algebra concepts. Students for the duration of two years need to remember the entire algebra curriculum concepts and successfully apply these concepts to pass the final state algebra examination at the end of a 2-year algebra course. Janie and Emma both articulated the challenge for students to retain algebra concepts.

Janie stated:

> The students forget algebra concepts taught the day before and need to be reinstructed the next school day. Waiting for the duration for two years to take the state assessment is too long of [a] time for students in the 2-year algebra course. The students have to remember so much for one test. Our students will forget material if they see it is not currently necessary. As soon as you finish a unit of study, you need to make sure you keep having those concepts on a weekly review; otherwise, the students forget them. They are not retaining those skills, so a weekly review is extremely necessary (I, April, 2017).

Emma expressed:

> We need more benchmarks to hold those kids accountable [to prepare the students for the end of year algebra examination]. We cannot wait until the end of the two years for that high stakes assessment. When it comes to the higher-level algebra, I

> think they struggle because they are not fluent enough with their algebraic skills coming into ninth grade at that point (I, April, 2017).

To remediate this retention concern, the teachers suggested a mid-course examination similar to the final state algebra examination to prepare students for the "high stakes assessment" (Emma, I. April, 2017). Teachers expressed the importance for providing an assessment opportunity after the first year of the 2-year algebra course to identify the algebra topics students need more instructional opportunities to practice and relearn in the course to improve comprehension.

Student Factors

Interviews with the teachers uncovered concerns about students' learning needs when they entered the course. Student dispositions and formative assessments were themes that provided a descriptive account to explain the need for providing the 2-year course option to improve student achievement. Teachers explained the importance of understanding the different levels of learners in the course to improve and strengthen student understanding of algebraic concepts.

Student learning needs. While all of the students were placed in the 2-year algebra course to increase their chance of success, the teachers expressed concern about students' readiness to learn algebra. Janie explained the students are "entering high school without foundational mathematics skills" (I, April, 2017). Janie further noted "the students do not have the skills to enter into the [2-year algebra] course and are coming in typically weaker in math, so a lot of the kids who are in algebra received math AIS (Academic Intervention Services) in middle school are now enrolled in a rigorous mathematics course without remediation support" (I, April, 2017). During Janie's interview, she was probed to give an example of observed student readiness for algebra. Janie shared:

> The kids pass grade levels and courses whether or not they completely understand the material or not. Many of the students enrolled in the 2-year course have not passed middle school math. You may have a kid, who really stopped learning math at third grade, but they will just keep moving on, and that is having the greatest impact on their ability to pass the [algebra] class. They don't have the prerequisite skills. They are just pushed through (I, April, 2017).

Janie’s concern about the students’ prior experiences and support for learning mathematics revealed insight about students’ readiness to learn algebra. Students enrolling in a grade nine algebra course without achieving proficiency in middle school mathematics courses creates a difficult challenge for students to pass both the course and final state algebra examination. These students did not satisfactorily meet the requirements for the middle school mathematics courses. The 2-year algebra course’s goal to support students to achieve proficiency in algebra was a challenging task.

As a result of these concerns about the students' readiness, the course teachers needed to know their students mathematical understanding to provide instructional strategies that would improve student understanding of algebraic concepts. Sarah felt strongly the teacher's role was needed to provide strategies to allow each student to create their own "foundation to go further" (I, April, 2017). Janie explained, "In the 2-year course, the students lack the understanding enough to articulate where they are missing it, so the teacher has to be able to look at their work and speak with them step-by-step and see where they are missing it" (I, April, 2017). The teachers' insight about each student's conceptual understanding needs to connect to specific algebraic concepts was critical. For example, Emma explained the specific areas of the algebra curriculum were difficult for the students to learn. She discussed the importance of knowing which of the algebra concepts students struggled with regularly to provide targeted support for the students. Emma explained: "The lack of their number sense and fluency with manipulating algebraic expressions is what prevents them from being able to do the higher-level algebra. In the 2-year course, the students know that it takes time to process, [and] that they need that extra day to revisit whatever it was that we were talking about the first day. [These students] are ready roll-up their sleeves and practice [with the previously learned algebra concepts]" (I, April, 2017). Feedback from the teachers suggests the 2-year course provided more opportunities within the course for teachers to build algebraic understanding and bolster readiness skills. The students were both comforted and willing to spend more time developing and applying the topics from the algebra curriculum than quitting because of their frustration with the rigorous algebra topics.

In conclusion, the 2-year algebra course teachers provided a vivid account of the learning needs of students and the obstacles faced by students to successfully learn algebra. Chapter three provided data how mathematics student performance in middle school may relate to student algebra performance. The findings from an independent samples *t*-test showed the relationship for student performance on the Grade Eight Mathematics State Assessment and the final state algebra examination. There was no statistically significant difference between the percentages of SWD passing the Grade Eight State Mathematics Assessment and the percentage of SWD who pass the final state algebra examination, $t\ (12) = .605$, $p > .001$. The teachers believed students were not passing mathematics prior to the grade nine algebra course contributed to the challenges felt by students to comprehend the rigorous algebra curriculum.

Student formative assessment. The teachers' knowledge of students' learning needs as they entered the course was only the first step. The teachers used a variety of formative assessment techniques to gather evidence and adjust instruction for their students. Teachers expressed the importance of providing opportunities for students to engage in the distributive practice (i.e., instruction in the classroom that was broken into more than one lesson over a period of time to support comprehension for an algebraic topic) to retrieve and apply learned algebra concepts to support retention. For example, Sarah designed a "daily pre-lesson review" (Sarah, I, April, 2017). Before the start of class, each student would complete two to three algebra problems previously learned in the algebra course. Sarah suggested that this type of evaluation provided the opportunity for students to become focused and ready to begin the algebra lesson (I, April, 2017). Sarah used interleaving, or mixed practice, to boost retention and help students make connections from one algebraic concept to another (Roediger & Pyc, 2012). Other teachers used daily formative assessment techniques to provide regular and explicit feedback to the students. For example, the teachers conducted daily (i.e., exit tickets) and weekly routines (i.e., pre-assigned days of the week in the algebra course for algebra homework) for students to apply and demonstrate learning of algebra course concepts. Incorporating differentiated instruction practices in the algebra course promoted student learning by providing opportunities for the teachers to collect data about student understanding and for the students to review previously learned algebra concepts (Roediger & Pyc, 2012).

Feedback from the teachers appeared to criticize the student understanding of the algebra topics when assessing their knowledge of algebra assessments. Implementing routine formative assessments during the course facilitated the support for the identification of algebra skills the students need more time to develop to attain success. One other form of formative assessment needed to be implemented and discussed earlier in the course factors section was implementing a mid-course formative assessment. Emma suggested the 2-year algebra course could also provide a formative evaluation administered at the end of the first year, which would be the midpoint of the course. She explained, "Creating a practice 2-year algebra course examination for students to take at the conclusion of the first year of the 2-year algebra course [is needed for the 2-year algebra course students]" (I, April, 2017). The outcomes on the examination would identify algebra concepts the students have mastered and algebra concepts teachers would need to target during the second year of the 2-year course before students take the final state algebra examination at the end of the next school year.

The teachers' deep understanding of their students' readiness to learn algebra coupled with regular opportunities to collect formative assessment data and then apply this knowledge to instruction was important to these teachers. The teachers wanted to monitor and adjust the instructional time in the 2-year course to confirm student comprehension. Providing distributed interleaved practice strategies such as the algebra course's weekly review (i.e., worksheet with eight previous final state algebra examination questions to solve) homework assignment reinforces students to retrieve the knowledge of content and to apply the skill successfully.

Student Summative Assessment

In 2015 and 2016, the combined passing mean score on the final state algebra examination for the 2-year algebra course was 65 (*SD* = 11) compared to 53 (*SD* = 15) for SWD in the 1-year algebra course. Teachers argued that the number of SWD achieving a passing score for the summative assessment was a challenging goal for students to achieve because of the question complexity. As previously discussed in chapters three and five, the content included on the examination was challenging because most of the questions were multiple-step word problems and it was especially difficult for SWD, according to the teachers, to solve for these computations accurately (Appendix G).

Accuracy. The interviews revealed details about the final state assessment required for students to pass for a state high school diploma. Two teachers expressed concern that the examination was not an accurate assessment of a student's proficiency in algebra. Emma explained:

> No, I do not really think it is an accurate assessment in either course because I do not believe the questions they put on that assessment truly allow the students to demonstrate what they know about algebra and about the topics that we learned throughout the year. You are not sure if that [final state algebra examination] was testing them on reading, because there are many times on the final [state algebra] examination that the reason the students will get the question wrong was because of the way it was worded and the reading, and not because they did not understand the concept that was behind [the question]. That is why [the final state

> algebra] examination is just, to me, not an accurate measure [of student] performance and knowledge of algebra content (I, April 2017).

Emma's feelings disclose the required final summative assessment is "not an accurate measure" (I, April, 2017) to pinpoint students who are competent in algebra. Improvement in the structure and wording for summative assessment algebra questions need to reflect the student's ability to demonstrate a competency in algebra and not reading comprehension. Sarah shared, "No, I do not think it is a fair assessment" (I, April 2017). She explained how the students in the 2-year course had difficulty remembering content from the first year of the 2-year algebra course to proficiently demonstrate mastery. Responses from teachers support the argument that the student outcomes on the final state algebra examination were not a fair summative assessment to determine student proficiency in algebra. In fact, the teachers explained students did not pass the final state algebra examination because the questions were difficult and the assessment did not reflect the actual algebra competency for students.

Examination content. The students' passing performance on the final state algebra examination was articulated by the 2-year algebra course teachers as an unfair assessment required for students. Judy shared:

> The questions are ridiculous on the state assessment. It is just so hard. It is just so ridiculously hard. Make the questions easier. Especially with the 2-year [course], how are the kids going to remember stuff from a year and a half ago (Judy, I, April, 2017).

Judy added, "The 2-year course's disadvantage is that they have to remember so much for one test. They have to remember material for two years" (Judy, I, April 2017).

Emma’s response complemented Judy’s beliefs about the accuracy of the summative assessment to determine student proficiency in algebra. Emma explained,

> I do not really think it is an accurate assessment because I do not believe that the questions they put on that assessment truly allow the students to demonstrate what they know about algebra and about the topics that we learned throughout the year (I, April, 2017).

Emma further revealed her “biggest critique” (I, April, 2017) of the summative assessment was the inaccuracy to determine a student’s algebra proficiency. The complexity of the examination questions makes it a challenge for students to pass. Emma argued:

> The fact that students are trying to solve the questions that require multiple steps and in doing so, sometimes the questions feel convoluted because they are trying to make them such higher-level thinking questions and in the end, you don't even really know what that was testing the kids on. You are not sure if that was testing them on reading, because there are many times on the algebra exam that the reason the students will get the question wrong was because of the way it was worded and the reading and not because they did not understand the concept that was behind (I, April, 2017).

Student passing performance on the final state algebra examination was a vital factor and goal for the 2-year algebra course. Teachers expressed preparing students to pass the final state algebra examination was critical to support students to meet the requirements for a high school diploma. For instance, the Review and Examination Module was one of the modules included in the 2-year algebra course. The purpose of the module was to prepare students for the challenging questions frequently included on the summative assessment. Including instructional time during the 2-year course to review the algebra course topics and use previous final state algebra examinations contributed to supporting students to attain proficiency. Reviewing for the final summative assessment was one of the key course elements to help students with varying levels of learning attain proficiency. In summary, the teachers explained the requirement for students to achieve a passing score on the final state algebra assessment was an unreasonable mandate.

Instructor Factors

The interviews revealed instructor beliefs about the 2-year algebra course and the students' feelings about the necessity for additional instructional support outside of the designated class time. The instructor factors included themes that pertained to the instructional perspective and additional instructional support for the 2-year algebra course. The research question was examined and provided quantitative results to support the 2-year course intervention.

Instructor beliefs. Teachers described concerns about two factors they believed impacted students' progress and success. Teachers used and applied homework practices as a regular feature of the course. They also believed their ability to adjust instruction in response to students' algebraic fluency needs was a key factor that contributed to students' success.

As discussed earlier in chapter five, homework was consistently assigned to students three days a week. Homework was graded, and students who do complete homework are required to stay after school to complete the assignment for zero credit. Judy, a general education mathematics teacher, shared, [in] "the 2-year course the kids do not do the homework like the 1-year course" (I, April, 2017) suggesting if the students did the homework, they would be more successful.

In the 2-year algebra course, homework was designed to provide feedback to both the students and the teachers. When students do not complete homework, the teachers may feel they do not accurately know about students' comprehension and retention of the material, which may then be impacting their instructional decision-making. While Judy's comment suggests the 2-year algebra students do not complete the homework, she does not offer an explanation about what might be preventing students from complying with the homework requirement.

Another belief raised by the teachers centered around the students' algebraic procedural fluency needs. One teacher, Emma, expressed students were at a disadvantage when learning algebra concepts because the concepts instructed in pre-algebra for students when in grade eight were not effectively learned. Emma shared, "When it comes to the higher-level algebra, students struggle because they are not fluent enough with their algebraic skills coming into ninth grade at that point. The lack of their number sense and fluency with manipulating algebraic expressions is what prevents them from being able to do the higher-level algebra" (I, April, 2017).

In response to students' algebraic fluency needs, the 2-year algebra course teachers used the doubled instructional time to understand their students' particular learning needs more deeply as a way to facilitate the students' knowledge of algebra concepts. Janie, a special education teacher, explained the slower pace supported the comprehension of rigorous algebra concepts to allow students to retrieve and apply knowledge proficiently. Janie shared, [providing time and] "encouraging the understanding for a smaller group of kids, so there is less urgency to push through the content [is necessary to increase algebra fluency for the students enrolled in the 2-year algebra course]" (I, April, 2017). The pace appeared to benefit the teachers' opportunities to work with students individually to support students' capacity to proficiently learn, retain, and apply knowledge of algebra skills. As Sarah, a special education teacher, so clearly stated, "Once I am working with them one-on-one, then they've got it, [and] the light bulb comes on" (I, April, 2017). The teachers shared their belief in regard to the positive impact having the additional instructional year to have more time to support student learning and retention of algebra topics. The teachers credited the slower pace to encourage opportunities to check for student understanding of algebra topics and having the more instructional time to reteach a topic if the students need help comprehending.

During the teacher interviews, both Janie and Emma expressed how most students in the 2-year algebra course option do not like mathematics. Janie explained, "A lot of kids just grow up afraid of math [and find it] is socially acceptable to say, 'I am not good at math.' We don't typically hear that in the other courses" (I, April, 2017). Emma expressed that students were entering the 2-year algebra course without passing mathematics in middle school and how this impacts their dislike for mathematics. (I, April, 2017). Janie shared:

> Then the feeling is perpetuated, and then students see something where in math they are also learning problem-solving skills and reasoning skills, so they come in, and they are working on the assumption that they just don't get it, or that they can't do it, so they don't even try or they won't even start; whereas in English, if

> they get a piece of text that is difficult, they at least think that they can skip some of the text and try to figure it out (I, April, 2017).

The students have negative outcomes and perceptions about mathematics in middle school. Emma discussed how the students were overwhelmed and frustrated with the rigor of the algebra course. (I, April, 2017). Janie explained the students would not voluntarily enroll in any high school mathematics course if they could graduate from high school without the requirement. Throughout each of the teacher interviews, they discussed the desire for the students to succeed in algebra and to change their attitude about mathematics. Emma shared:

> It is rewarding for me to see a student overcome an obstacle with a topic in mathematics and finally make a connection with it and have that success. To know that I was able to help a student get there is rewarding to me (I, April, 2017).

The teachers do not want students to fear or hate mathematics. Their secondary goal after helping the student pass and earn the algebra credit was to encourage students to enroll in more rigorous mathematics courses during high school. Mathematics courses like Geometry and Algebra II can prepare the students for the rigor of a college mathematics course.

In summary, the teachers shared some beliefs of the 2-year algebra course. First, was the importance to promote more opportunities for students to get individual help to ensure algebra fluency. A second belief was the importance of having consistent homework assignments to check for student understanding and comprehension of algebra computations. A third belief was for the 2-year algebra course teachers to be mindful of student perceptions about mathematics. Many of the students in the 2-year algebra course have had below average or failing grades in mathematics during middle school and were not motivated to attend the algebra course. Overall, the teachers felt both the design of the 2-year algebra course and teacher sensitivity to student attitudes toward algebra were essential to support student achievement for algebra.

Additional instructional support. Providing additional instructional support was deemed essential by teachers when interviewed. Two teachers expressed the need for additional instructional support to aid students with the challenges of the algebra curriculum content. Sarah expressed that co-instruction within the 2-year course supported and provided instructional support for students, but students needed an additional period for instructional support (I, April, 2017). The additional period of instructional support provided students the opportunity to have algebra concepts reinstructed to support student proficiency (I, April, 2017). Janie discussed, "The need to including the time in the school schedule to provide additional algebra re-instruction is necessary" (I, April, 2017). Emma explained having the extra instructional help for all algebra courses made a difference for students understanding the algebra topics. Emma felt it is necessary to "provide a time and a place for a student to get additional help outside of class, it would make a big difference, I think, in their [algebra] performance (I, April, 2017).

Another concern influencing the teachers' abilities to teach the 2-year algebra course effectively was the need to provide students additional support to attain algebra proficiency successfully. Additional instructional support was defined as the time provided during the school day to re-teach and check for student understanding of rigorous algebra concepts. The 2-year algebra course's additional year provides opportunities for students to learn at a slower pace to maximize their fluency in algebra. However, students needed additional opportunities provided to them during the school day to promote their comprehension of algebra concepts. Instructional intervention support options provided were daily after-school help, a daily placement of Resource Room, the learning center to support students during the school day, and a weekly class period of mathematics lab. After-school help provided by each team of co-teachers in their classroom was available for the students. During the school day, the learning center was an option for students to get instructional support for their algebra course from the special education teacher assigned to the teaching placement position, and the Resource Room placement provided opportunities for reinstruction and homework support for students mandated by their IEP during the school day.

Lastly, teachers expressed the importance of providing the service of additional instructional interventions to support student learning and comprehension of algebra content. Some students needed to have another period during the school day to have the algebra curriculum content reinforced and re-taught (Emma. I. April. 2017). The 2-year algebra course teachers saw the value of giving students who needed additional instructional support opportunities to be successful in algebra. Providing additional instructional time helped student comprehension and achievement in the 2-year course. Overall, the instructional factors suggested key ideas that can influence the co-teachers' ability to teach the course effectively.

Summary of Interviews

The research question examined the relationship between the end of year mathematics achievement scores for students who take different length algebra courses, 1-year option and 2-year option, for SWD on the final state algebra examination. Overall the quantitative findings of the study were statistically significant in 2016 and not statistically significant in 2015. Therefore, a further study to examine the 2-year algebra course and its unique components (i.e., smaller class size) are needed to determine if the 2-year algebra course is a successful intervention. The qualitative findings from the teacher interviews support the implementation of the 2-year algebra course to provide instruction to students to earn the algebra credit required for a high school diploma. In the 1-year algebra course, the class sizes have large enrollments, and the pace for instructing the required algebra course concepts moves at a quick pace. The 1-year algebra course does not provide opportunities within the class period to reteach content instructed the day before. As Judy stated:

> More stuff is done in the 1-year course at home, whereas in the 2-year course we can take some of those homework questions and discuss them together and go through them. In the 1-year course, we are just giving the answers, and we move on (I, April, 2017).

According to the teachers, if students from the 1-year algebra course do not grasp an algebra concept, it is their responsibility to get instructional support from their teacher. The teachers in the interview expressed how the additional time and pacing of the 2-year algebra course support the success of students passing both the algebra course and final state algebra examination. The 2-year algebra course supported student learners who needed additional instructional time to comprehend and apply algebraic curriculum. The small class size allows both course co-teachers to provide attention and support to each student to be sure the algebra curriculum was learned. While the results for 2016 were significant (Table 6.6), the data alone do not tell if the significant findings were a result of the additional year of instructional time, decreased class size, or another variable.

In summary, the four teacher interviews provided a deeper examination of the factors associated with student performance in the 2-year algebra course. The co-teachers of the 2-year algebra course were motivated and committed to teach the 2-year algebra course. The teachers' attitudes and determination to provide an algebra course option to support student understanding of the algebra content contributed to creating a positive learning environment. Emma explained, "It is rewarding for me to see a student overcome an obstacle with a topic in mathematics and finally make a connection with it and have that success (I, April, 2017). Teachers explained the 2-year algebra course increased the students' success in algebra and was a successful option to improve student proficiency on the final state algebra examination. During interviews, the teachers shared their belief that providing the 2-year algebra course option impacted positively on student algebra performance by providing more instructional time and smaller class size.

Discussion

After the implementation of a 2-year algebra course in a suburban high school, the passing rate on the final state algebra examination for SWD was not conclusive because statistically significant findings were only found in one of the two years studied. Another study to further examine additional years of students' test score performance on the final state algebra examination is warranted. This new study should examine a larger sample size of students over a longer period enrolled in the 2-year algebra course as compared to similar students (i.e., matched on a variety of variables including class size) to rule out chance and to determine if there is a trend for greater success in students enrolling in the 2-year algebra course or students enrolled in the traditional 1-year algebra course.

The current study took place over the course of two consecutive school years, 2015 and 2016. Although the results for 2015 were not statistically significant and, therefore, cannot be generalized, the results for 2016 were found to be significant; however, the small sample size necessitated using the Brown-Forsythe Test of Equality of Means. In 2015, SWD enrolled in the 1-year algebra course had a mean score of 52. The final state algebra examination has 37 questions equaling to a total raw score of 86 points. The raw score is converted to a 100-point scale score (i.e., raw score of 86 points equals a scale score of 100 points). A score of 65 is passing. The mean score of 52 from the 1-year algebra course in 2015 for SWD was approximately one standard deviation away from the mean score of 62 for a student with disability in 2-year algebra course (Table 6.3). SWD from the 1-year algebra course in 2015 scored in the bottom 15% of all students who participated in the final state algebra examination.

Table 6.6 combined the findings for both 2015 and 2016 for SWD participation on the final state algebra examination for both the 1-year and 2-year algebra course options. The performance of SWD on the final state algebra examination did reach statistical significance (p = .00), SWD enrolled in the 2-year algebra course (M = 65, SD = 11) had more passing scores on the final state algebra examination compared to SWD enrolled in the 1-year algebra course (M = 53, SD = 15). Even though this analysis demonstrates statistical significance, it is difficult to draw a definitive conclusion or recommendation that the 2-year course option is superior. Most of the significance in the Table 6.6 analysis comes from the larger sample size seen in 2016.

The total students (i.e., general education and special education) participating in the 2015 1-year algebra course had a mean score of 65 (Table 6.2). Overall in 2015, the mean score of 65 was achieved by both the 1-year and 2-year algebra course students. In 2015, 15 out of 30 SWD from the 2-year algebra course passed the final state algebra examination, but the students are passing at the lowest possible level to attain proficiency (i.e., passing score of 65 and the mean score of the group was also 65). Most of the 2015 scores for the students in the 2-year algebra course ranged between 58 and 72 ($SD = 7$), whereas the scores of the students in the 1-year algebra course fall between 55 and 75 ($SD = 10$). The findings demonstrated in 2015 the SWD in the 2-year algebra course were able to achieve the same final state algebra examination mean as students without a disability in the 1-year algebra course with very similar standard deviation distribution of scores. This implies that the accommodations (i.e., including reduced class size) built into the 2-year algebra course designed to assist SWD may be a promising approach to helping students to achieve proficiency.

In 2016, the total participants in the 1-year algebra course had a mean score of 73 compared to a mean score of 65 for students enrolled in the 2-year algebra course (Table 6.2). The increased mean score from 65 in 2015 to 73 in 2016 could reflect fewer SWD participated in the ($n = 7$) 1-year algebra course compared to 2015 ($n = 16$). The mean scores for SWD in the 2-year algebra course remained constant at 65 from 2015 to 2016.

The testing data findings support the beliefs shared in the teacher interviews along with the findings from studies included in the literature review for providing the 2-year algebra course, which allows for more overall time on the algebra curriculum and more individual time in the classroom for SWD who meet the enrollment criteria.

Key Aspects for Study Findings

The testing data (i.e., 2015 and 2016 final state algebra examination) findings were important to analyze the success of the 2-year algebra course option to improve the SWD performance on the final state algebra examination. Factors such as additional instructional time to provide more opportunities to review and teach algebra topics, implementing a slower pace and smaller class size to improve student understanding of the algebra topics, and small enrollment size for 2-year algebra course may have all contributed to the SWD to attaining algebra proficiency. Teacher interview responses further support the implementation of the 2-year algebra course to provide students the learning environment to proficiently comprehend and apply the algebra topics to attain the required algebra achievement.

The teachers expressed the importance for including more instructional time to effectively and successfully instruct SWD. Providing more opportunities to understand and process the algebra concepts was necessary for the students enrolled in the 2-year algebra course to attain success. Emma shared,

> The students that I believe would be in the 2-year course are the students who know that it takes them time to process, that they need that extra day to revisit whatever it was that we were talking about the first day to really roll up their sleeves and practice with it (I, April, 2017).

Janie added to the belief shared by Emma by explaining how the 2-year algebra course provided "a smaller student-teacher ratio where that is not possible in the 1-year course" and the “flexibility you can quiz them and move them along at their own pace to make sure they fully understand the material” (I, April, 2017). Class size and student to teacher ratios were determined when the 2-year algebra course was created to not exceed 15 students with two teachers. While the traditional 1-year algebra course does not limit the student to teacher ratio. The implementation of the 2-year algebra course afforded students the opportunity to comprehend the rigor of the algebra course content and achieve algebra achievement. As Emma explained,

> “[In the 2-year algebra course] we try to focus on one topic at a time to make sure that they are demonstrating proficiency on a particular topic before we move to the next one so that we know they have that topic secure” (I, April, 2017).

In summary, the format of the 2-year algebra course to provide an additional instructional year to slow down the pace of the algebra course to increase student comprehension was important. Many SWD enrolled in the 2-year algebra course earned passing scores on the final state algebra examination (Table 6.6).

As presented, the data in the study do not allow one to conclude whether the slower pace of the 2-year course or the smaller student to teacher ratio was critical to improved student performance. It is theoretically possible, for example, that small student to teacher ratios in a 1-year course of study would have provided similar results. Future research should include variables designed to independently measure the impact of both the slower pace of the 2-year course and the small class size.

The overall findings support the possibility that the intervention of a 2-year algebra course that allows small class size with more individual attention and a slower pace could be a promising intervention to improve student understanding of algebraic topics and to successfully pass the required final state algebra examination. The factors and measurements included in the Final Conceptual Framework (Figure 5.1) accurately represented the vital components required to successfully teach students to achieve a passing score on the final state algebra examination.

Combined Findings

Collectively, the studies included in the literature review, the responses from the teacher interviews support the benefits of a 2-year algebra curriculum course; however, the testing data did not demonstrate a conclusive statistically significant benefit for the 2-year algebra course. The co-teachers described the delivery of the 2-year algebra course as providing the flexibility to provide additional time to support student comprehension of algebra topics.

Importance of Study Findings

The findings (i.e., quantitative and qualitative) for the implementation of the 2-year algebra course were important to show how implementing an additional year of instruction to include a slower pace (Faulkner, Crossland, & Stiff, 2013), small class enrollment (Ellerbrock & Kiefer, 2013; Glass & Smith, 1978), use of IEP testing accommodations (Jones & Hensley, 2012), and providing instructional interventions (Idol, 2006) may make a difference in supporting students for achieving a passing algebra score. Instruction in the 2-year algebra course needs the flexibility to review and reinstruct algebra topics to students when mastery is not being attained. Emma expressed,

> Obviously, algebra is the foundation for all of those other [mathematics] courses. It is the most important, so you have to make sure that you have those things secure if you are going to be successful moving on. If you need that time, then

> you should take that time. You do not want to have gaps and misunderstandings and then just leave them (I, April, 2017).

Providing the additional instructional time to support the understanding of algebra topics and incorporating instructional strategies (Foegen, 2008; Van Garderen et al., 2009) to help students learn and solve abstract algebraic computations are important. Emma shared,

> "We [need to] provide a time and a place for the [2-year algebra] class; it would make a big difference in their performance" (I, April, 2017).

The teachers expressed incorporating a slower pace and strategies to improve students' knowledge contributed to the success of the 2-year algebra course (Figure 5.1). In conclusion, the findings for implementation of the 2-year algebra course were a result of the many collective key elements implemented by both the course co-teachers to support the learning environment for SWD retain and apply the knowledge gained from the setting of the 2-year algebra course.

Recommendations

A definitive recommendation supporting enrollment in the 2-year algebra course for students with disability cannot be made given the limitations of this data set. The research question for the study was to analyze the relationship between the end of year algebra summative scores for students who take different algebra courses, 1-year option and 2-year option, for SWD on the final state algebra examination. When the result of the testing data for SWD from 2015 and 2016 was combined, the data reached statistical significance; however, when analyzed separately only the testing data from 2016 showed a statistically significant difference between the 1-year and 2-year algebra course for

SWD (Table 6.6). This lack of statistical power and significance in the testing data, therefore, does not support the implementation of the 2-year algebra course as an intervention to improve student performance.

It is recommended to conduct additional studies to examine more years of students with disabilities' performance on the final state algebra examination for both the 2-year and 1-year algebra course options. Examining more years of student testing performance on the final state algebra examination may be able to rule out chance findings and identify a trend. These additional studies need to examine the impact of specific variables including classroom instructional strategies, classroom enrollment size, pace, and individual attention to determine if any of these variables contribute to students with disabilities' algebra achievement. Matching student groups for demographics to include race, socio-economic status, gender, age, and specific special education classification for the cohort years being studied may provide additional findings and strengthen data analysis. Future research to include the different characteristics for the SWD in the study is recommended. The additional research may identify a possible trend for SWD who participate in the 2-year algebra course who have an academic learning disability or who may have a disability unrelated to academic goals (i.e., behavioral). The additional studies should also match individual student performance on both their Grades Seven and Eight State Mathematics Assessments to their performance on the final state algebra examination.

Two key factors of (a) more years of data for the 1-year and 2-year algebra course options of student testing performance on the final state algebra examination and (b) a larger sample size to include more 1-year and 2-year algebra course options for students and possibly other enrolled algebra students also located in the identified state are recommended to examine the effectiveness of the 2-year algebra course intervention. Along with a larger sample size and additional years of testing data, the impact of variables of instructional strategies, class size, and pace for students enrolled in algebra are necessary to ensure no confounding factors contributed to the outcomes for the study. Additional investigative studies should include (a) the 1-year algebra course with a class size greater than 15 students, (b) the 1-year algebra course with small class size (i.e., 15 students or less), (c) the 1-year algebra course with instructional strategies specific for supporting SWD, (d) the 2-year algebra course with a class size greater that 15 students, (e) the 2-year algebra course with small class size (i.e., 15 students or less), and (f) the 2-year algebra course with instructional strategies specific for supporting SWD. Examining each of the factors will allow the breakdown to determine what factors may impact SWD passing performance on the final state algebra examination.

The additional studies would also benefit from ensuring the demographics be equally balanced in both the control and treatment groups. For example, the 2-year algebra course option to include a small size enrollment cannot include only high socio-economic, white, female students. By balancing each variable within each control and treatment group, the data collected can be better assessed and improve the validity of the results.

Another recommendation by the teachers in interviews was to provide a pre-algebra course for students to take in high school prior to enrolling in the algebra course. The pre-algebra course they described would be taken by students in grade nine, and then the students in grade ten would be enrolled in the traditional 1-year algebra course instead of the 2-year algebra course. The pacing of the algebra course curriculum may not provide the needed instructional time to teach students pre-algebra content the student should have previously learned.

Implementing a final algebra assessment for students in the 2-year algebra course to take in June, at the end of the first year of the 2-year algebra course was suggested by 2-year algebra course teachers. The mid-course final examination should be designed in the same structure as the final state algebra examination. The teacher interviews recommended providing an opportunity for students in the 2-year algebra course to demonstrate proficiency in algebra curriculum that was instructed in the first year of the 2-year algebra course. Emma shared in her interview,

> "I feel like we cannot wait until the end of the two years for that high stakes assessment. I feel like there needs to be something else on regular intervals where the kids are practicing and getting prepared for a bigger assessment in that way that counts for them so that they have practice for that leading up to the exam." (I, April, 2017).

The assessment can provide an opportunity for students to experience the testing format and time allotment along with the rigor of questions included on the final state algebra examination. Student outcomes on the mid-course examination will provide both the students and teachers with feedback about reviewing algebra curriculum in preparation for the final state algebra examination.

Future research is recommended to continue providing professional development sessions to support both co-teachers of the 1-year and 2-year algebra courses. The professional learning sessions provided special education teachers with the opportunity to become familiar and proficient with the content of the algebra course. Providing professional development opportunities for the general education teachers to learn about best practices to accommodate instruction for SWD can promote the effectiveness of the course intervention to support student achievement of the algebra curriculum. The responses explained how the current 2-year algebra course teachers were committed to the 2-year algebra course option to support student achievement. The selection of teachers to collaborate on instruction for the 2-year algebra course should be teachers who expressed interest in working as an equal with another teacher. The special education co-teacher needs to be knowledgeable about the algebra content to provide the instructional support for students to achieve algebra proficiency. Additionally, co-teachers need to be knowledgeable about instructional strategies and student learning accommodations per students' IEPs to provide meaningful instruction that will support students comprehending the algebra curriculum concepts. In summary, having the support of the 2-year algebra co-teachers can further the fidelity of the 2-year algebra course.

Limitations

The study had several limitations including the small sample size, different special education classifications and levels of learning for SWD, and access to student IEPs. One of the limitations for this study was examining data for a single, suburban school district in one state from the United States and the data was not from a controlled sample. The data and conclusions might not be relevant to other districts of different size, location, and demographics.

A second limitation was the sample from this study did not examine the different classifications and learning levels of students who were identified within special education. Specific SWD characteristics and labels (i.e., learning and behavioral) were not examined. The SWD classified with profound and severe disabilities were not included in the study. Some special education students are very high functioning whom many excelled in general education programs. However, there are students classified special education who may require different accommodations that are unable to be achieved by lengthening the algebra course.

A third limitation was the small sample size of data. The limitation resulted in the data findings for both 1-year and 2-year algebra courses for 2015 not reaching statistical significance. More students participating in the 2-year algebra course would provide more individual test scores to increase the sample size and lend more power to certain aspects of the study. The *t*-tests are not valid between groups of vastly different sizes and could only be used to examine data from 2015. In 2016 the large difference in group size required using an ANOVA Brown-Forsythe Test was used to examine the finding for two groups who do not have equal means. Overall, a recommendation cannot be made about the implementation for a 2-year algebra course impacting the passing rate on the final state algebra examination for SWD.

A fourth limitation were restrictions to examine and view IEPs for SWD. Students enrolled in the course have an IEP that includes annual learning goals. Knowledge of annual learning goals and the specific classification of disability (i.e., learning disabled) is confidential. Limited information to include testing accommodations and curriculum accommodations are provided to the special education co-instructor of the 2-year course.

The researcher does not have access and permission to examine SWD IEP. Access to IEPs for student participants in the 2-year course would provide information regarding the additional instructional support (i.e., curriculum and testing accommodations) a student may need in order to meet the requirements of the algebra course.

A fifth limitation for the study was the student populations for the 1-year and 2-year algebra courses were not matched across the age, demographics, gender, and race. Matching these groups was not possible given the small numbers examined and the retrospective nature of the study; however, matched groups would have added value to the results.

A sixth limitation for the study was that the retrospective nature of the study did not allow the researcher to follow the students from the Grade Eight State Assessment to the final state algebra examination. This would have allowed an analysis of the impact of a 2-year algebra course in greater detail. The study did not have a control for the variables of classroom instruction and class size.

Summary

Most SWD did not successfully pass the Grade Eight State Mathematics Assessment in the identified school district (Appendices C, E, and L). As discussed earlier in chapter two (Appendices C, E, and L), student performance on the Grade Eight State Mathematics Assessment revealed a statistically significant correlation for student performance on the final state algebra examination for the identified high school. From 2013 to 2015 (Table 6.8), 147 SWD participated on the Grade Eight State Mathematics Assessment, and only six SWD successfully passed. The identified school district had a 4% per year passing rate for SWD.

Table 6.8

State Grade Eight Mathematics Assessment Results for Students with a Disability Students

Year	2013	2014	2015
Total SWD Students	73	49	25
Total SWD Students Pass	3	2	1

SWD=students with disabilities.

Together, the data from the literature review, qualitative data from teacher interviews, and quantitative testing data did not demonstrate a conclusive statistically significant benefit for the 2-year algebra course. Thus, a definitive recommendation supporting enrollment in the 2-year algebra course for students with disability cannot be made given the limitations of this data set.

In summary, the needs assessment findings showed the Grade Eight State Mathematics Assessment supported a relationship for performance on the final state algebra examination. In the identified school district, many of the students who failed the Grade Eight State Mathematics Assessment also failed the final state algebra examination. Student performance on the Grade Eight State Mathematics Assessment remained a valid tool for deciding which students would benefit from the 2-year course option.

Finally, the findings suggest another study to examine more years of student testing data, student demographics, classroom strategies, pace, and individual attention to determine if the 2-year and 1-year algebra courses demonstrate improved student performance on the final state algebra examination. Examining additional years of student testing performance on the final state algebra examination may be able to rule out chance findings and show a trend for both student enrollment in the 2-year algebra course and performance on the final state algebra examination.

Given the data as analyzed and discussed to include acknowledging the data limitations, the continuation of the design for the 2-year algebra course should remain a 2-year course option for SWD while additional research continues to confirm its impact or the effect of smaller class sizes in the 1-year option. Key components of the 2-year algebra curriculum that should be maintained while further data are collected includes professional development for co-teachers, eligibility of enrollment, small class size, slower instructional pace, and continued use of multiple representations (i.e., visual models and concrete manipulatives) such as the Four Diamond and Corner Graphic Organizer (Zollman, 2012). A continuation of implementing strategies such as Cover, Copy and Compare (Mulcahy et al., 2014) and the STAR (Maccini & Ruhl, 2000) should also be continued in the 2-year algebra course to provide learning opportunities in the classroom for students to solve multiple-step word problems accurately.

Additionally, consideration should be given to adding pre-algebra curriculum to the 2-year algebra course. A pre-algebra curriculum could include pre-testing algebra concepts to strengthen students' mathematics foundation. Further opportunities to solidify algebra learning would include after-school support and interleaving assessments.

Moving forward, the dissertation research and mixed methods analysis for the intervention of a 2-year algebra course provided the researcher with suggestions for her new role as a professor for instructing and advising undergraduate teacher candidates. A focus on critically evaluating data and the use of evidence-based practices will be consistently used as an indispensable tool to design curriculum, guide the professional development of teacher candidates, and will be applied rigorously to future professional academic challenges.

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Appendix A. Informed Consent Form

Johns Hopkins University

Homewood Institutional Review Board (HIRB)

Informed Consent Form

Title: State Algebra Exam and Special Education: Change in Graduation Requirements

Principal Investigator: Christine Eith, JHU School of Education
Student Investigator: Aimee E. Herzog-Gruber, JHU School of Education

Date: March 16, 2015

PURPOSE OF RESEARCH STUDY:

The primary purpose of this study is to investigate the impact of recent changes to graduation requirements resulting in a single type of diploma. This study will also assess how the State Regents Algebra course can be improved to increase proficiency for students with a disability. Furthermore, the study will examine whether the seventh and eighth grade student with a disabilities' performance on the State Mathematics Assessment connects their performance one the Final state algebra examination. Responses from teacher interviews along with examining students with a disability performance on the State Grades Seven and Eight Mathematics Assessment and the final state algebra examination and will be examined.

PROCEDURES:

The principal investigator has selected specific State Teachers to be informally interviewed in a semi-structured, one to one environment. Each teacher will be asked eight questions that will be tape recorded for accuracy. The teacher interviews will be transcribed and examined from each teacher's perspectives regarding how the revised Regents' Diploma and algebra requirement impact students with a disability and teachers. Time required for the interview is 30 minutes.

The principal investigator will compile each of the teacher's interview responses to be examined for common themes. The State Department of Education website will provide exams scores.

RISKS/DISCOMFORTS:

We do not anticipate any risks to you participating other than those encountered in daily life.

BENEFITS:

There are no direct benefits from this study. The information from this study may benefit other people now or in the future in the way schools in the state under the Regents' Diploma guidelines are implementing requirements of algebra for the various types of disabilities by those classified a special education. The potential indirect benefit is for a greater understanding and increased success rates for students with a disability in algebra.

VOLUNTARY PARTICIPATION AND RIGHT TO WITHDRAW:

Your participation in this study is entirely voluntary: You choose whether to participate. If you decide not to participate, there are no penalties, and you will not lose any benefits to which you would otherwise be entitled.

If you choose to participate in the study, you can stop your participation at any time, without any penalty or loss of benefits. If you want to withdraw from the study, please contact Aimee E. Herzog-Gruber (aherzog7@jhu.edu).

If we learn any new information during the study that could affect whether you want to continue participating, we will discuss this information with you.

CONFIDENTIALITY:

Any study records that identify you will be kept confidential to the extent possible by law. The records from your participation may be reviewed by people responsible for making sure that research is done properly, including members of the Johns Hopkins University Homewood Institutional Review Board and officials from government agencies such as the National Institutes of Health and the Office for Human Research Protections. (All of these people are required to keep your identity confidential.) Otherwise, records that identify you will be available only to people working on the study, unless you give permission for other people to see the records.

All data collected for this study will be de-identified by substituting a participant number for the person's name prior to analysis.

COMPENSATION:
You will not receive any payment or other compensation for participating in this study.

IF YOU HAVE ANY QUESTIONS OR CONCERNS:

You can ask questions about this research study now or at any time during the study, by talking to the researcher(s) working with you or by calling Aimee E. Herzog-Gruber, Principal Investigator for this study at aherzog7@jhu.edu.

If you have questions about your rights as a research participant or feel that you have not been treated fairly, please call the Homewood Institutional Review Board at Johns Hopkins University at (410) 516-6580.

SIGNATURES

WHAT YOUR SIGNATURE MEANS:

Your signature below means that you understand the information in this consent form. Your signature also means that you agree to participate in the study. By signing this consent form, you have not waived any legal rights you otherwise would have as a participant in a research study.

____

Participant's Signature **Date**

____

Signature of Person Obtaining Consent **Date**

(Investigator or HIRB Approved Designee)

Please sign below if you are willing to have this interview recorded on audiotape. You may still participate in this study if you are not willing to have the interview recorded.

____

Participant's Signature **Date**

Appendix B. Teacher Interview Questions

1. Do you think the State Mathematics Assessment for grades seven and eight are an indicator for how successful a student will be when taking algebra?

2. What scores on the Grades Seven and Eight State Mathematics Assessment need to be identified for students entering algebra who may have difficulty with the course and examination?

3. What are the three most common learning skills students with a disability exhibit in algebra class that contribute to their lack of success?

4. In general, what elements about the algebra course framework commonly give the students with a disability difficulty?

5. What support systems outside of the algebra course are beneficial in helping students with a disability meet proficiency in algebra?

6. When students with a disability fail the algebra course and examination are they more successful at the second attempt?

7. Is mandating all students in the identified state, in particular students with a disability, to earn a Regents' Diploma a realistic option?

8. How do you accommodate and adapt curriculum to meet the needs of students with a disability?

Appendix C. Sample Grade Seven Mathematical Assessment Questions

Example One:

Erin wants to make a sandwich from the main ingredients shown in the table below.

Bread	**Main Ingredient**
Sourdough (S)	Peanut butter (P)
Wheat (W)	Ham (H)
Rye (R)	Turkey (T)
	Egg salad (E)

On the lines below, list all the possible ways Erin can make a sandwich using one type of bread and one main ingredient.

Example Two:

What is the surface area, in square centimeters, of a rectangular prism that has a length of 10 centimeters, a width of 5 centimeters, and a height of 6 centimeters?

A 140
B 160
C 280
D 300

Example Three:

Which number is the square root of 196?

A 12
B 14
C 16
D 18

Appendix D. Grade Seven State Mathematics Assessment Results

Table D1

Grade Seven Middle Schools A, B, and C

Year	2006	2007	2008	2009	2010	2011	2012
Total Students	644	646	636	648	571	568	605
Total GE Students	533	511	510	544	464	470	502
Total SWD Students	111	135	126	104	107	98	103
Total Students Pass	608	621	620	646	454	550	586
Total GE Pass	525	507	508	544	462	466	496
% GE Pass	.98	.99	.99	1.0	.99	.99	.99
Total SWD Pass	83	114	112	102	92	84	87
% SWD Pass	.75	.84	.88	.90	.86	.86	.84

GE= students in general education; SWD=students with disabilities.

Appendix E. Sample Grade Eight Mathematical Assessment Questions

Example One:

Complete the table below to create a pattern that shows a linear relationship between *x* and *y*.

x	*y*
1	
2	
3	
4	

Write an equation that can be used to represent the relationship between *x* and *y* in your table.

Example Two:

Solve the equation for p. $3(p+6) + 5p + 4$

Example Three:

The scale on a road map is shown below.

SCALE
1 cm = 75 mi

Sam measures the distance on the map between Rockland and Newbury as 5 centimeters. What is the actual distance, in miles, between Rockland and Newbury?

A 15

B 80

C 375

D 575

Appendix F. Grade Eight State Mathematics Assessment Results

Table F1

Grade Eight Middle Schools A, B, and C

Year	2006	2007	2008	2009	2010	2011	2012
Total Students	675	624	614	624	649	562	560
Total GE Students	541	519	486	500	542	493	491
Total SWD Students	134	105	128	124	107	104	96
Total Students Pass	640	601	586	614	623	539	540
Total GE pass	535	514	482	500	538	454	462
% GE pass	.99	.99	.99	1.0	.99	.92	.94
Total SWD pass	105	87	104	114	85	85	78
% SWD pass	.78	.83	.81	.92	.79	.82	.81

GE= students in general education; SE=students with disabilities.

Appendix G. Sample State Regents Algebra Examination Questions

Example One:

During its first week of business, a market sold a total of 108 apples and oranges. The second week, five times the number of apples and three times the number of oranges were sold. A total of 452 apples and oranges were sold during the second week. Determine how many apples and how many oranges were sold the *first* week. [Only an algebraic solution can receive full credit.]

Example Two:

Using his data on annual deer population in a forest, Ken found the following information:

25th percentile: 12

50th percentile: 15

75th percentile: 22 Minimum population: 8 Maximum population: 27

Using the number line below, construct a box-and-whisker plot to display these data.

Example Three:

A thermos in the shape of a cylinder is filled to 1 inch from the top of the cylinder with coffee. The height of the cylinder is 12 inches and its radius is 2.5 inches. State, to the *nearest hundredth of a cubic inch*, the volume of coffee in the thermos.

The actual side of a square tile is 4 inches. The manufacturers allow a relative error of 0.025 in the area of a tile. Two machines are used to cut the tiles. Machine A produces a square tile with a length of 3.97 inches. Machine B produces a square tile with a length of 4.12 inches. Determine which machine produces a tile whose area falls within the allowed relative error.

Appendix H. State Regents Algebra Results

Table H1

High Schools A and B Algebra Data

Year	2006	2007	2008	2009	2010	2011	2012
Total Students	736	783	697	502	522	621	572
Total GE Students	568	639	540	435	394	475	432
Total SWD Students	168	144	157	82	128	146	140
Total Students to Pass	673	732	662	572	484	589	537
Total GE Students Pass	566	633	535	491	370	465	419
% GE Students Pass	.99	.99	.99	.99	.94	.98	.96
Total SWD students pass	107	99	127	81	114	124	118
% SWD Students Pass	.64	.69	.81	.87	.89	.85	.84

GE= students in general education; SWD=students with disabilities.

Appendix I. State Regents Graduation Data Results

Table I1

High Schools A and B Graduation Data

Year	2006	2007	2008	2009	2010	2011	2012
Total Students Graduated	582	581	580	637	550	577	560
Total RE Diploma	509	522	528	601	518	549	520
Total GE RE Diploma	469	496	480	548	443	495	458
% GE RE Diploma	.94	.95	.96	.99	1.0	1.0	1.0
Total SWD RE Diploma	40	26	48	53	75	54	62
% SWD RE Diploma	.57	.32	.55	.51	.70	.66	.61

GE= students in general education; SWD=students with disabilities; RE=Regents Diploma.

Appendix J. Hypothesis 1 Statistical Findings Grade Seven

Table J1

Chi-Square Test of Independence Findings for Hypothesis 1-Grade Seven State Mathematics Assessment Performance

	2006		2007		2008		2009		2010		2011		2012	
Groups	% Pass	% Not Pass	% Pass	% Not Pass	% Pass	% Not Pass	% Pass	% Not Pass	% Pass	% Not Pass	% Pass	% Not Pass	% Pass	% Not Pass
General Ed	98	2	99	1	99	1	100	0	99	1	99	1	99	1
Special Ed	75	25	84	16	88	12	90	10	86	14	86	14	84	16
Chi-square	20.7		12.6		8.23		8.52		10.4		10.4		12.6	
p –value	.00		.00		.00		.00		.00		.00		.00	

General Ed= students in general education; Special Ed=students with disabilities.

Appendix K. Hypothesis 1 Statistical Findings Grade Eight

Table K1

Chi-Square Tests of Independence Findings for Hypothesis 1-Grade Eight State Mathematics Assessment

	2006		2007		2008		2009		2010		2011		2012	
Groups	% Pass	% Not Pass	% Pass	% Not Pass	% Pass	% Not Pass	% Pass	% Not Pass	% Pass	% Not Pass	% Pass	% Not Pass	% Pass	% Not Pass
General Ed	99	1	99	1	99	1	100	0	99	1	92	8	94	6
Special Ed	78	22	83	17	81	19	92	8	79	21	82	18	81	19
Chi-square	19.65		13.74		16.06		6.38		18.43		3.58		6.58	
p-value	.00		.00		.00		.01		.00		.06		.01	

General Ed= students in general education; Special Ed=students with disabilities.

Appendix L. Hypothesis 2 Statistical Findings for Special Education

Table L1

Chi-Square Test of Independence Findings for Hypothesis 2-State Regent's Algebra Examination Performance

	2006		2007		2008		2009		2010		2011		2012	
Groups	% Pass	% Not Pass	% Pass	% Not Pass	% Pass	% Not Pass	% Pass	% Not Pass	% Pass	% Not Pass	% Pass	% Not Pass	% Pass	% Not Pass
General Ed	99	1	99	1	99	1	99	1	94	6	98	2	96	4
Special Ed	64	36	69	31	81	19	87	13	89	11	85	15	84	16
Chi-square	38.3		31.3		16.1		7.21		1.03		9.3		6.7	
p-value	.00		.00		.00		.01		.31		.00		.01	

General Ed= students in general education; Special Ed=students with disabilities.

Appendix M. Hypothesis 3 Statistical Findings

Table M1

Chi-Square Test of Independence Findings for Hypothesis 3-State Regents Diploma Performance

	2006		2007		2008		2009		2010		2011		2012	
Groups	% Earn	% Not Earn	% Earn	% Not Earn	% Earn	% Not Earn	% Earn	% Not Earn	% Earn	% Not Earn	% Earn	% Not Earn	% Earn	% Not Earn
General Ed	94	6	95	5	96	4	99	1	100	0	100	0	100	0
Special Ed	57	43	32	68	55	45	51	49	70	30	66	34	61	39
Chi-square	35.03		89.93		43.25		58.91		32.98		38.59		46.00	
p-value	.00		.00		.00		.00		.00		.00		.00	

GE= students in general education; Special Ed=students with disabilities.

Appendix N. Hypothesis 4 Statistical Findings for General Education

Table N1

Independent Samples t-Test for Hypothesis 4-Performance on State Regents Algebra and Grade Eight Mathematics Assessment for General Education Students

		2006		2007		2008		2009		2010		2011		2012	
Examination	Groups	Pass	Not Pass	Pass	Not Pass	Pass	Not Pass	Pass	Not Pass	Pass	Not Pass	Pass	Not Pass	Pass	Not Pass
Algebra	General Education	99	1	99	1	99	1	99	1	94	6	98	2	96	4
Grade 8 Math	General Education	99	1	99	1	99	1	100	0	99	1	92	8	94	6
t-test	-.206														
N	7														
p-value	.18														

Appendix O. Hypothesis 4 Statistical Findings for Special Education

Table O1

Independent *Samples t-Test for Hypothesis 4-Performance on State Regents Algebra and Grade Eight Mathematics Assessment for Students with a Disability*

		2006		2007		2008		2009		2010		2011		2012	
Examination	Groups	% Pass	% Not Pass	% Pass	% Not Pass	% Pass	% Not Pass	% Pass	% Not Pass	% Pass	% Not Pass	% Pass	% Not Pass	% Pass	% Not Pass
Algebra	Special Education	64	36	69	31	81	19	87	13	89	11	85	15	84	16
Grade 8 Math	Special Education	78	22	83	17	81	19	92	8	79	21	82	18	81	19
t-test	.605														
N	7														
p-value	.06														

Appendix P. Regents 2-year Algebra Curriculum Map

80 days	• M1: Relationships Between Quantities and Reasoning with Equations and Their Graphs
50 days	• M2: Descriptive Statistics
70 days	• M3: Linear and Exponential Functions
60 days	• M4: Polynomial and Quadratic Expressions, Equations and Functions
40 days	• M5: A Synthesis of Modeling with Equations and Functions
60 days	• Review and Examinations

Figure P1. State Regents 2-year course algebra curriculum map.

Appendix Q. Regents 1-year Algebra Curriculum Map

40 days	• M1: Relationships Between Quantities and Reasoning with Equations and Their Graphs
25 days	• M2: Descriptive Statistics
35 days	• M3: Linear and Exponential Functions
30 days	• M4: Polynomial and Quadratic Expressions, Equations and Functions
20 days	• M5: A Synthesis of Modeling with Equations and Functions
30 days	• Review and Examinations

Figure Q1. State Regents 1-year algebra curriculum map.
Note. Retrieved from the SED (2016a) website.

Appendix R. Four Corner and Diamond Graphic Organizer

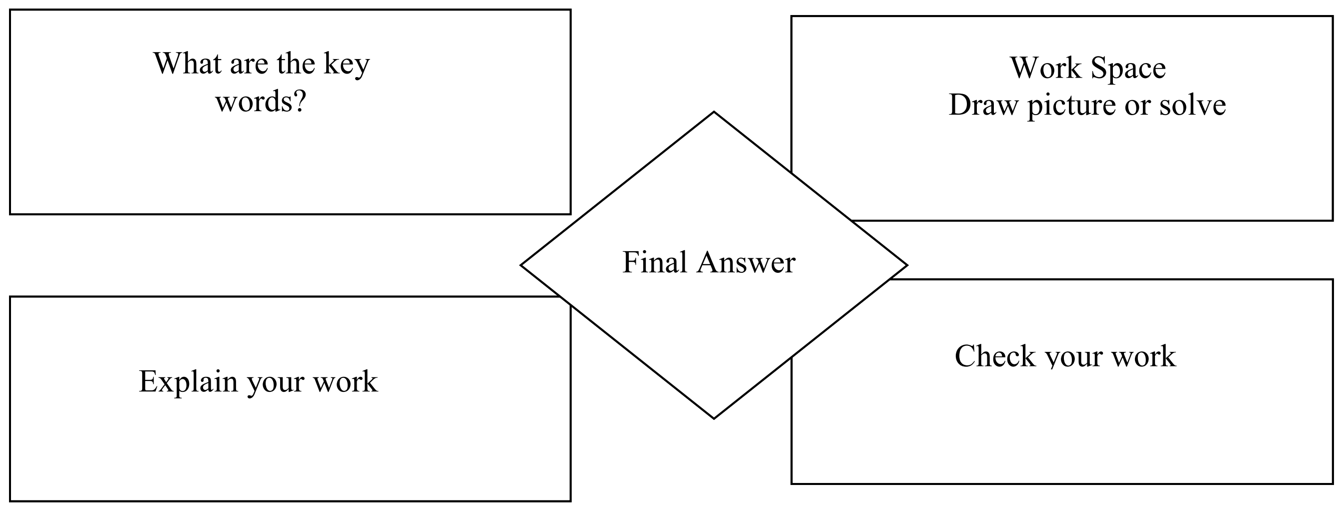


Figure R1. Four corner and diamond graphic organizer.
Note. Four corners and diamond organizer as proposed from Zollman (2012).

Appendix S. Effect Size

Table S1

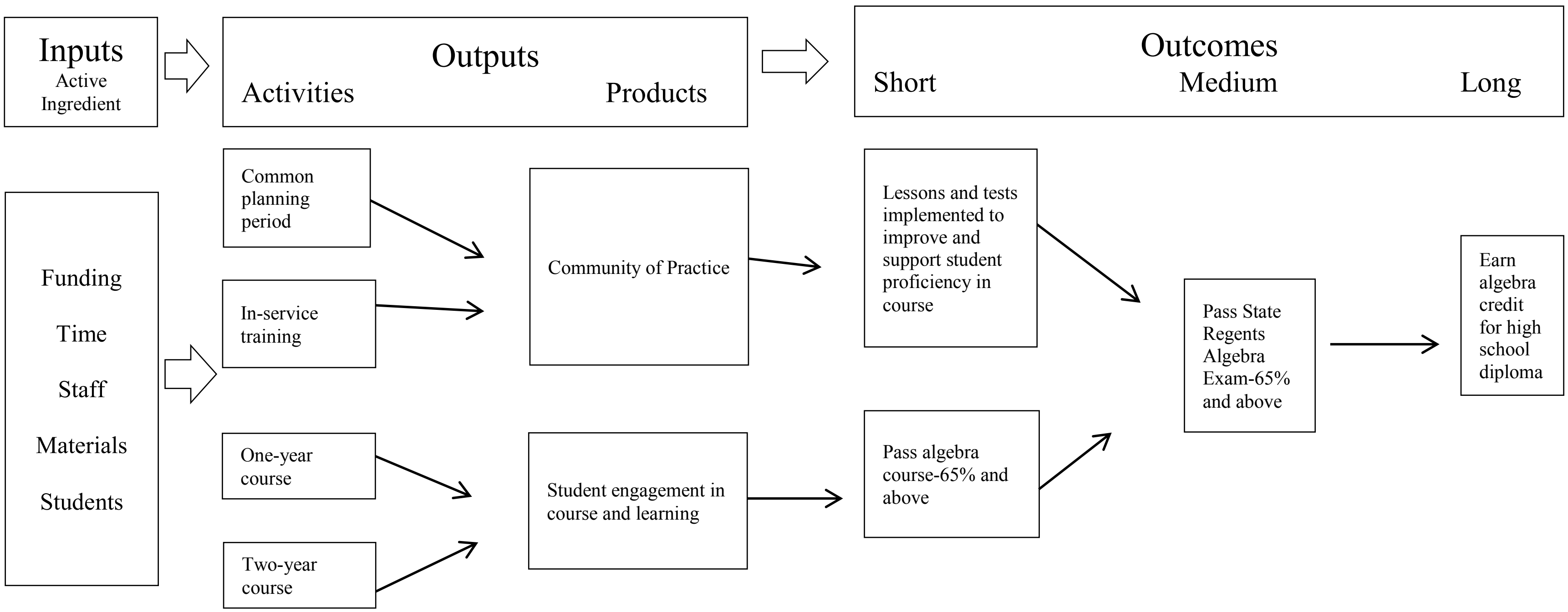
Effect Size for State Regents Algebra Data

Algebra Course	N	
2-year (i.e., 2015)	30	
2-year (i.e., 2016)	44	
1-year (i.e., 2015)	195	
1-year (i.e., 2016)	221	
Total Participants	490	
p = Cohen's *d*	.05	0.25

Note. Computed using the Campbell Collaboration Website (2016.) for *t*-test, *p* value, and unequal sample sizes.

Appendix T. Logic Model 2-year Algebra Course

Situation: Students in the state need an algebra credit (passing both the algebra course and final state algebra examination) to earn a high school diploma.



Assumptions:
*Special education teachers are competent in teaching algebra
*Regular education teachers are familiar with teaching strategies to support weak learners and students with a disability
*All students can meet algebra proficiency and earn a State Regents Diploma

External Factors:
*Individual student learning abilities
*School district funding eliminated or reduced
*State changing graduation requirements for students with a special education classification

Appendix U. Informed Consent Form

Johns Hopkins University

Homewood Institutional Review Board (HIRB)

Informed Consent Form

Title: State Algebra Exam and Special Education: Change in Graduation Requirements

Principal Investigator: Karen Karp, Ed.D., JHU School of Education

Student Investigator: Aimee E. Herzog-Gruber, JHU School of Education

Date: March 21, 2017

PURPOSE OF RESEARCH STUDY:

The primary purpose of this study is to investigate the effect of recent changes to graduation requirements resulting in a single type of diploma. This study will also assess how an Algebra course can be improved to increase proficiency for students with a disability. The study will examine whether the implementation of a 2-year algebra course and eighth grade students with a disability's performance on an end of year state mathematics assessments. Responses from teacher interviews who taught these courses along with examining students with a disability's performance on the state mathematics assessments will be anonymous. Each teacher participant will sign off in a written email consenting to not discuss any confidential information nor are they representing the district is necessary, any confidential student information, and all interviews are from your perspective and are not meant to represent the school district.

PROCEDURES:

The principal investigator has asked teachers to volunteer to be interviewed in a semi-structured, one-to-one environment. Each teacher will be asked eight questions that will be audio recorded for accuracy. The teacher interviews will be transcribed and examined from each teacher's perspective regarding how the revised course delivery impacts students with a disability and teachers. Teachers will discuss the implementation of the 2-year algebra course. Time required for the interview is 30 minutes.

The principal investigator will compile each of the teacher's interview responses to be examined for common themes. The State Department of Education website and participating school district will provide students exams scores.

RISKS/DISCOMFORTS:

We do not anticipate any risks to you participating other than those encountered in daily life.

BENEFITS:

There are no direct benefits from this study. The information from this study may benefit other people now or in the future in the way school's guidelines are implementing requirements of algebra in multiple delivery platforms for the students with disabilities. The potential indirect benefit is for a greater understanding and increased success rates for students with a disability in algebra.

VOLUNTARY PARTICIPATION AND RIGHT TO WITHDRAW:

Your participation in this study is entirely voluntary: You choose whether to participate. If you decide not to participate, there are no penalties, and you will not lose any benefits to which you would otherwise be entitled.

If you choose to participate in the study, you can stop your participation at any time, without any penalty or loss of benefits. If you want to withdraw from the study, please contact Aimee E. Herzog-Gruber (aherzog7@jhu.edu).

If we learn any new information during the study that could affect whether you want to continue participating, we will discuss this information with you.

CONFIDENTIALITY:

Any study records that identify you will be kept confidential to the extent possible by law. The records from your participation may be reviewed by people responsible for making sure that research is done properly, including members of the Johns Hopkins University Homewood Institutional Review Board and officials from government agencies such as the National Institutes of Health and the Office for Human Research Protections. (All of these people are required to keep your identity confidential.) Otherwise, records that identify you will be available only to people working on the study, unless you give permission for other people to see the records.

All data collected for this study will be de-identified by substituting a participant number for the person's name prior to analysis.

COMPENSATION:

You will not receive any payment or other compensation for participating in this study.

IF YOU HAVE ANY QUESTIONS OR CONCERNS:

You can ask questions about this research study now or at any time during the study, by talking to the researcher(s) working with you or by calling Aimee E. Herzog-Gruber, Principal Investigator for this study at aherzog7@jhu.edu.

If you have questions about your rights as a research participant or feel that you have not been treated fairly, please call the Homewood Institutional Review Board at Johns Hopkins University at (410) 516-6580.

SIGNATURES

WHAT YOUR SIGNATURE MEANS:

Your signature below means that you understand the information in this consent form. Your signature also means that you agree to participate in the study. By signing this consent form, you have not waived any legal rights you otherwise would have as a participant in a research study.

Participant's Signature **Date**

Signature of Person Obtaining Consent **Date**

Appendix V. Teacher Interview Questions

1. What are the major differences between the regular 1-year algebra and the 2-year algebra courses?

2. How were the lessons for each course (1-year algebra and the 2-year algebra courses) the same or different?

3. Describe two instructional strategies provided in the 2-year course that supports student achievement of algebra concepts that are not possible in the 1-year course?

4. Why do you believe these strategies support student achievement in algebra?

5. Which algebraic concepts did your students find difficult to master?

6. What were the difficulties that students exhibited when confronting these concepts?

7. Do you think you are more effective in supporting student learning in the 2-year course or the 1-year course? Explain your justification or evidence from instructing the 2-year course.

8. Do you feel that the final state examination is an accurate assessment of student achievement in the 2-year algebra course? For which content domains did the state provide an accurate assessment of achievement?

9. What are the key differences in the preparation for the state assessment for students in the 1-year and 2-year courses?

10. For which students (i.e., describe their learning characteristics) is the 2-year algebra course a good idea and which students should not be placed in the 2-year option?

11. What are the disadvantages that a 2-year course presents to students? Are they put behind in mathematics forever? What are the advantages; do they continue in mathematics whereas they might otherwise quit? What is the impact on students with a disability?

12. In the future, do you think any changes need to be made to the eligibility of enrollment for students in the 2-year algebra course?

13. What changes would you recommend in the 2-year algebra course to increase student achievement? Why would these changes make a difference?

14. Identify two key structures (i.e., co-instruction, after school help, and weekly review assignment) for the 2-year algebra course that promotes effective instruction for enrolled students?

15. What algebra course preference do you prefer teaching (1-year or 2-year) and why?

Appendix W. Coding for Interviews

A Priori Codes

Course Structure
- Small class size
- Additional Time
- Pacing
- Curriculum map
- Lessons
- Enrollment eligibility
- Testing Accommodations
- Student misconceptions
- Classroom discourse
- Concepts
- Procedures

Technology
- Video clips
- Graphing Calculator
- In-focus/Smart board/overhead projector
- Instructional interventions web sites

Instructional interventions
- After school help
- Resource Room
- Learning Center
- Math Lab
- Other (during lunch and study halls)

Instructor Attitudes
- Instruction
- School district support
- Teacher efficacy

Co-teaching
- Planning
- Instruction

Student Learning
- Achievement areas
- Improvement areas

Grade Eight Examination

- Course content on test
- Grading
- Student outcomes

Algebra Examination

- Course content on test
- Grading
- Student outcomes

Emerging Codes

Teacher answered question themselves

2-year Algebra Course Goals

- additional period of mathematics instructional interventions
- implementation of a foundation and pre-algebra
- to improve accuracy of student enrollment in grade nine for algebra.

Inhibiting factors

- school attendance
- reading skills
- input from Grade Eight teachers
- retention of curriculum concepts for two years

Student Assessment

- mid-course examination
- daily pre-lesson review

Appendix X. Interview Field Notes

2-year algebra course	Question Analysis	Field Notes	Suggestions for 2-year algebra course
Algebra examination	Do you feel that the final state examination is an accurate assessment of student achievement in the 2-year algebra course?	Judy- more time to review Emma- not an accurate measure	*Provide more review*
Co-Teaching	Identify two key structures for the 2-year algebra course that promotes effective instruction for enrolled students?	Janie- helps us talk about different strategies	*Support co-teaching instruction*
Course Structure	Why do you believe these strategies support student achievement in algebra?	Lisa- slower pace to allow for more practice Judy- twice as much time spent on content	*Continue with 2-year curriculum map*
2-year Algebra Course Goals	In the future, do you think any changes need to be made to the eligibility of enrollment for students in the 2-year algebra course?	Judy- foundations course on pre-algebra curriculum Janie- a pre-algebra course for students entering grade nine	*Consider creating a pre-algebra course*
Inhibiting factors	Do you think you are more effective in supporting student learning in the 2-year course or the 1-year course?	Janie- attendance is horrible Janie- forget algebra concepts taught the day before	*Reinforce review activities such as the weekly reviews*
Instructor Attitudes	For which students is the 2-year algebra course, a good idea and which students should not be placed in the 2-year option?	Emma- fluency with manipulating algebraic expressions is what prevents them from being able to do the higher-level algebra	*Examine ideas to strengthen skills*
Instructional Interventions	What were the difficulties that students exhibited when confronting these concepts?	Janie- time in the school schedule to provide additional algebra reinstruction Emma- Provide a time and a place outside of class	*Investigate instructional intervention ideas*
Student Learning	What are the disadvantages that a 2-year course presents to students?	Janie- entering high school without foundational mathematics skills Judy- weak in the basic skills	*Discussion with grade eight teacher to implement changes*
Student Assessment	What changes would you recommend in the 2-year algebra course to increase student achievement?	Lisa- daily pre-lesson Emma- examination to take at the conclusion of the first year	*Discuss implementing final assessment at end of Year One*

Appendix Y. Curriculum Vitae

Aimee E. Herzog-Gruber

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Education

Johns Hopkins University **2014-2018**

Ed.D. in Education

State University of New York at Potsdam **1997-1998**

M.S. Elementary Education

State University College of New York at Buffalo **1992-1996**

B.S. Exceptional Education

Experience

Assistant College Professor **2017-present**

Murray State University, Murray, Kentucky
College of Education and Human Services

- Lecturer for Special Education Program
- 2 + 2 Education Coordinator, Paducah Site

Teaching Assistant **2016-2017**

Johns Hopkins University, Baltimore Maryland
School of Education Doctoral Department

- Doctoral Research Methods I Course
- Doctoral Research Methods II Course
- Doctoral Evaluation of Education Policies and Programs Course

Adjunct College Professor **2011-2012**

State University College at Buffalo, Buffalo, New York
Department of Special Education

- Graduate Collaboration Course
- Undergraduate Classroom Management Course

Teacher –Special Education **2000-2012**

Kenmore West Senior High School, Buffalo, New York

- Resource Room
- 15:1 English 10
- 15:1 English 11
- 15:1 English 12

Teacher –Special Education **1999-2000**

Tonawanda Junior High School, Tonawanda, New York

- Resource Room
- Co-taught Grade Seven Mathematics
- Co-taught Grade Eight Mathematics

Teacher –Special Education **1996-1999**

H.T. Wiley Elementary School, Watertown, New York

- Resource Room-Grade Five
- Self-Contained Classroom-Grade Four